FROM ZERO TO 1:1 IN 30 YEARS
THE EVOLUTION OF
DIGITAL INSTRUCTIONAL TECHNOLOGY
IN A SUBURBAN KANSAS SCHOOL DISTRICT, 1984 - 2014

By

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From Zero to 1:1 in 30 Years
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Abstract

Digital instructional technology, those technologies used by teachers and/or students to assist with teaching and learning, continues to be an ever-changing and rapidly expanding integrated component in K-12 education in classrooms across the country. As school districts across the state and the country continue to wrestle with making fiscally-responsible decisions, there is a need to understand the influencing factors surrounding both the adoption and benefits of digital instructional technology use and the factors impacting decisions to use or not use these technologies.

This case study exploration of digital instructional technology was guided by the central question: *How has digital instructional technology evolved over time in a large suburban Kansas school district and what has influenced its adoption and use/nonuse?*

The primary findings of this study were: A) The current use of digital technologies adopted by the district over thirty years are varied; B) Equity, standardization, and financial feasibility contributed to the adoption of digital instructional technologies; C) Elements of external influences were noted throughout all of the user-defined eras with respect to the selection and adoption of digital instructional technologies; D) Teachers' non-involvement with the decision-making process and their beliefs surrounding the benefits of digital instructional technologies may impact teachers' frequency of use/nonuse, and E) Digital instructional technology adopted by this district has largely targeted improving teacher instruction as guided by various stakeholder priorities.

This study contributes to the overall understanding of the evolution of digital instructional technology in one Kansas district over a defined period of time. It gives voice to the perspective of multiple stakeholders regarding the factors influencing the decision to adopt

digital instructional technology. Additionally, it provides potential guidance for future district leaders with respect to making digital instructional technology selection and adoption decisions.

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Chapter One

Introduction

Society in the 21st Century is increasingly dependent on technology in all facets of life. In the realm of education, digital instructional technology continues to command both financial and human resources in an effort to increase student achievement as measured by assessments. School districts, such as the suburban Kansas school district explored in this study, are challenged with making responsible and impactful decisions regarding digital instructional technology adoption. They are challenged with educating 21st Century learners with a 21st Century education and finding ways to financially support this endeavor. School Boards of Education and district stakeholders (e.g., parents, administrators, teachers, and students) are faced with the challenge of improving teaching and learning to include effective implementation of digital instructional technology tools and innovations. As district leaders strive to make informed decisions regarding the allocation of resources and subsequent adoption of digital instructional technologies, they must continually weigh technology-related expenditures against the educational impact of their investment so as to legitimize the allocation of funds to their constituents. This quandary has been an on-going challenge for the district explored in this study.

Research on digital instructional technology and related adoption demonstrates substantial disagreement exists regarding the funding, selection of technology tools, implementation, and perceived impact on student achievement. Further, digital instructional technology continues to be touted as a manner in which education might be revolutionized, contributing to its widespread adoption and rationalization for expenditure of funds. Moreover, district leaders, teachers and local communities often hold varying beliefs about the need for and benefit of use of digital instructional technology. The argument continues in many public schools as to whether the efforts to reform education in regards to student achievement should continue to be closely tied to and substantially impacted by district decisions to adopt and integrate the use of digital instructional technology tools and innovations. The question districts are faced with is: Does the integration of instructional technologies in classrooms positively impact the education of students termed "digital natives[1]?" The uses of traditional instructional tools (i.e., *pencil, paper, books and chalkboard*) have been replaced in many K-12 classrooms today with computers (Cuban, 2009) as well as newer technology innovations such as tablets, digital media and whiteboards. However, research is contradictory - showing increased academic achievement cannot always be directly correlated with increased expenditures in this technology arena (Cuban, 1986). This study offers an investigation into the factors leading to the adoption of digital instructional technology tools and innovations. Constructing a means for the expansion of knowledge in this area is crucial to providing new extensions of learning for those making such decisions in the future.

As the call for national educational reform continues to be a prominent topic in educational discourse, it is important for educators and district leaders to understand the possible impact of new digital instructional technology tools and innovations as a means of transforming the K-12 public school system. Traditional teacher pedagogy and beliefs regarding how students learn must be revisited and when necessary, realigned with new digital instructional technology innovations and integration. Thus, teaching, learning, assessments and technology innovations must all be in alignment in order to collectively become change agents for educational reform. The K-12 educational landscape is continually evolving in light of expanded use of digital instructional technologies; some technology adoptions may challenge what Tyack and Cuban term the *grammar of schooling (i.e.* the collective belief about what a school looks like;

[1] For this dissertation, a *digital native* is a person who was born during or after the general introduction of digital technologies and through interacting with digital technology from an early age, has a greater understanding of its concepts (Prensky, 2001).

classrooms, textbooks, teacher-led learning, report cards, etc.) (Cuban & Tyack, 1995). These expectations seemingly may be tested as digital instructional technologies and related teacher pedagogies evolve and expand (i.e. flipped classrooms, blended learning, 1:X initiatives).

Education itself is an institution and as such there are educational organizations (school districts) within the institution striving for legitimacy by adopting technology innovations from other educational organizations (other school districts) (Cuban, 2009). Absent conclusive research providing evidence about the educational impact of the adoption of technology innovations such as Bring Your Own Device[2] (BYOD) initiatives and One-to-One[3] (1:1) initiatives, as well as selection of various devices such as tablets, iPads and touch-screen whiteboards may suggest districts often make new purchasing decisions in an effort to appear to remain legitimate. However, mimicry of other districts cannot be the sole driving force for large-scale adoption of digital instructional technology tools and innovations. District leaders must also, via collaborative data-collection and investigation involving stakeholders, develop sound rationalization for purchase and adoption of digital instructional technology (Culp, Honey, & Mandinach, 2005). Thus, as new and innovative digital instructional technology tools become available and the pressure to adopt them continues to expand, additional research into the decision-making process of districts and the technology implementation process by teachers may inform future adoption decisions.

This study is guided by five questions:

1. How has digital instructional technology evolved over the past thirty years in one district?

[2] *Bring your own device* (BYOD) is an alternative strategy allowing employees, students and other users to utilize a personally selected and purchased client device to execute enterprise applications and access data. Typically, it spans smartphones and tablets, but the strategy may also be used for PCs and laptops.
[3] *One-to-One initiatives* are funded by districts and provide one digital device for every student.

2. What have been the key factors influencing a district's adoption or non-adoption of digital instructional technology innovations?
3. To what extent do teachers use available digital instructional technology?
4. What factors influence a teacher's decision to use available digital instructional technology?
5. What are the perceived benefits of the various digital instructional technologies adopted according to teachers?

This study provides an in-depth examination of the evolution of digital instructional technology tools and innovations implemented in a suburban school district in Kansas. The study further provides an analysis of the district's adoptions and deployments of various digital instructional technology tools over the past thirty years. Further, using interviews, this study describes and analyzes teacher perceptions and experiences as well as district leadership-level perceptions and experiences regarding the implementation of digital instructional technologies. Finally, the combined data is analyzed and interpreted in an effort to better understand the role of decision-makers surrounding these technology adoptions and inform future digital instructional technology initiatives.

Chapter Two

Review of the Literature

The literature review for this study is structured in five sections in order to provide a framework for understanding the chronological history and progression of the adoption and implementation of digital instructional technology tools in K-12 education. Additionally, challenges of technology integration and the benefits of said integration with regards to student academic performance will be discussed. The first section presents the concept of institutional theory to provide an explanation for organizational decision-making. The second section provides background information regarding theories of adoption of innovation to include diffusion theory. The relationship between institutional theory and diffusion theory provides a framework for understanding the manner in which technology innovations are adopted and spread. The third section provides a brief historical overview of the evolution of technology innovations adopted in K-12 education to include those currently debated in the educational sector today. The fourth section provides an overview of the issues encompassing increasing expenditures on digital instructional technology tools despite stagnant or decreasing local, state and federal aid to education; specific subsections include resource allocation and spending in K-12 education and various funding sources for purchasing digital instructional technology. The final section details many of the common challenges and benefits of the adoption and implementation of digital instructional technology tools in K-12 education for both teachers and students. This section also presents both challenges and benefits of specific digital instructional technology devices and innovations themselves. Together, these sections establish a conceptual framework for this study.

Institutionalism

Organizations frequently seek legitimacy in large part by mimicking other organizations. Institutional theory[4] and the concept of isomorphism[5] may be used as a foundation for connecting knowledge regarding why schools and districts adopt reforms and innovations which are less than effective in terms of achieving their stated objective in an effort to be seen as legitimate. In doing so, they may adopt reform initiatives, programs, ideas and processes from other organizations, regardless of whether are proven effective. They do so because these organizations are thought to have greater legitimacy than their own – and thus, the organizations wouldn't implement these reforms and/or initiatives if the reforms were not perceived as being effective. Organizations frequently strive to become structurally similar, and in some cases identical, to other organizations through isomorphism. Meyer and Rowan (1977) explain: "Organizations are driven to incorporate the practices and procedures defined by prevailing rationalized concepts of organizational work and institutionalized in society. Organizations do so in order to increase their legitimacy and their survival prospects, independent of the immediate efficacy of the acquired practices and procedures" (p. 340). The homogenizing forces that affect organizations are described as isomorphism, a constraining process that forces one unit in a population to resemble other units that face the same set of environmental conditions (Hawley, 1968). Isomorphism can be coercive, mimetic, or normative (DiMaggio & Powell, 2000). Coercive isomorphism stems from political influence and an example would be schools mandated to create and comply with federally mandated special education regulations. Mimetic isomorphism results from standard responses to uncertainty whereby one organization mimics

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[4] *Institutional theory* considers the processes by which structures, including schemas, rules, norms, and routines, become established as authoritative guidelines for social behavior (Meyer & Rowan, 1977).

[5] *Isomorphism* may be described as a constraining process that forces one unit in a population to resemble other units that face the same set of environmental conditions (Hawley, 1968).

other organizations in response to uncertainty. Normative isomorphism is associated with professionalism and an example prevalent in schools today is that of the adoption of professional learning communities (PLCs) as professional practice. Organizations often obtain and maintain legitimacy by responding to these types of isomorphic pressures. Though responses are often ritualistic, not genuine, they are still effective in maintaining legitimacy and resources (DiMaggio & Powell, 2000).

Schools, as organizations, are most likely to pursue legitimacy through normative and mimetic isomorphism due to goal ambiguity and technical uncertainty. According to Rowan (Rowan, 1982) educational innovations tend to have high levels of technical uncertainty and as a result can seldom be justified on a basis of solid technical evidence. Thus, educational innovations gain legitimacy via endorsement from other organizations. This aligns with normative and mimetic isomorphism in schools. Isomorphism takes place based on perceived effectiveness, not necessarily requiring research-based evidence of effectiveness. Adoptions of iPads, tablet or laptop computers are examples of an educational reform not currently supported by substantial research as being highly-effective for reaching educational goals. Nonetheless, these types of implementations are emergent trends gaining popularity, public backing, and legitimacy. Institutional theory suggest that in order to appear legitimate and to act as a neighboring district acts, a district may choose to devote substantial resources to this type of adoption. Simply put, if everyone else is doing it, we must need to do the same (implement the same type of innovation) in order to be also viewed as legitimate. The process of seeking legitimacy is a survival mechanism. Schools will attempt to mimic organizations they deem highly legitimate and in this manner, reforms grow and spread in number and dominance within the field of K-12 education (Rowan, 1982). In Oversold and Underused, Cuban (2009) further underscores that failure to fund investments in new technologies could be political suicide. According to Cuban (2009), a school's "very legitimacy depends in part on demonstrating" to various stakeholders that their school is a "good" school simply because it is equipped with technology (p. 159). The quality of the reform does not dictate legitimacy; rather, the number of organizations using it, the reform's compliance to legislative mandates, or the perception of it among the teaching profession, are ways in which reform efforts are endorsed without necessarily being vetted for validity or effectiveness.

A final contribution to the adoption of reforms is based on the concept by Tyack and Cuban (1995) termed the grammar of schooling. The grammar of schooling is the implied code that reflects the social theory of schooling in America. Reforms that require changes inconsistent to the grammar of schooling tend to fail, while reforms that reinforce the grammar of schooling tend to succeed Cuban (1995). The grammar of schooling represents institutionalized structures of the educational environment, such as instructional practices, student behaviors, physical school building, structure of school day, and grades. It is incumbent upon a school to adopt these institutionalized structures and promote only reform efforts that conform to their confines. Organizations adopting institutionalized structures gain three benefits: (1) legitimacy in the eyes of the local public and thereby goodwill, (2) cost benefit of adopting a time-tested concept over the costs of developing and promoting a new idea, and (3) less risk than choosing a novel or illegitimate structure (Rowan, 1982). Thus, schools are at an advantage when they adopt institutionalized structures according to the grammar of schooling which are already legitimate in the eyes of public. These structures or practices do not have to be proven effective.

The ambiguous nature of education lends itself to organizations seeking legitimacy through the pursuit of similar structures and patterns. Thus, the understanding of such influence networks and how information is used to formulate and validate decisions can often be used to explain the drive of K-12 districts toward legitimacy. This includes the isomorphic mimicking of the behavior of other districts' decisions regarding the adoption and implementation of digital instructional technology innovations.

Adoption and Diffusion of Instructional Technology

Multiple underlying theories may help to explain both the adoption and the diffusion of digital instructional technology innovations; however, Everett Roger's Diffusion of Innovations Theory (1995) is arguably the most influential when describing how a specific innovation is adopted and whether or not it gains access to or acceptance by a population or group (Straub, 2009). Diffusion theory provides a useful perspective on one of the most persistently challenging topics in education, that of improving digital instructional technology selection, adoption and implementation. Research on instructional technology adoption and subsequent diffusion has explored specific technologies such as hardware, software, microcomputers for teacher and student use, and devices for enhanced communication (i.e. mass media and interpersonal communication) by analyzing teacher consideration, adoption, and use in schools (Dooley, 1999; Sahin, 2006). As such, an increased awareness of diffusion and adoption theories is of potentially great benefit to future implementation of digital instructional technology. Classroom educators as well as leaders in digital instructional technology are faced with a growing awareness that innovative instructional tools and practices have been hindered by a lack of use and may benefit from better understanding of adoption and diffusion theories in an effort to increase the embracing of instructional technologies (Surry & Farquhar, 1997).

Adoption and diffusion theories are integrated with one another. Rogers (1995) adoption theory examines the individual and the choices an individual makes to accept or reject a particular innovation whereas diffusion theory examines the adoption and spread of an innovation over a period of time. Thus, the adoption process of a digital instructional technology innovation is closely related to the diffusion process. Once an innovation is adopted by individuals many factors work together to influence the diffusion of an innovation over a period of time by additional groups of communities. Rogers (1995) states, the four major factors are: (a) features of the innovation itself, (b) how information about the innovation is communicated, (c) time, and (d) the nature of the social system into which the innovation is being introduced (p. 10). In this regard diffusion theory seeks to understand how these and other factors interact to facilitate or hinder the adoption of a specific technology or practice among members of a particular adopter group. Roger's extensive work on adoption and diffusion theory is framed through the concept of time as illustrated in Figure 2.1 (Rogers, 1995). Adopters are categorized into groups based on the relative amount of time for a percentage of individuals to adopt an innovation, resulting in a diffusion curve. Rogers argues better success will ensue if early adopters and innovators are targeted for adoption first instead of trying to influence the entire population of a particular group or community. Straub (2009) states this is due to commonalities in personality, socio-economic situations, and communication behaviors (p. 628). Early adopters tend to have higher socio-economic status, have greater access to communication regarding the innovation and are also likely to be more literate and have a higher capacity for uncertainty for change (p. 631). Thus, these individuals are more likely to be willing to consider new innovations less of a threat and may be better capable of trouble-shooting any issues with the implementation of the innovation.

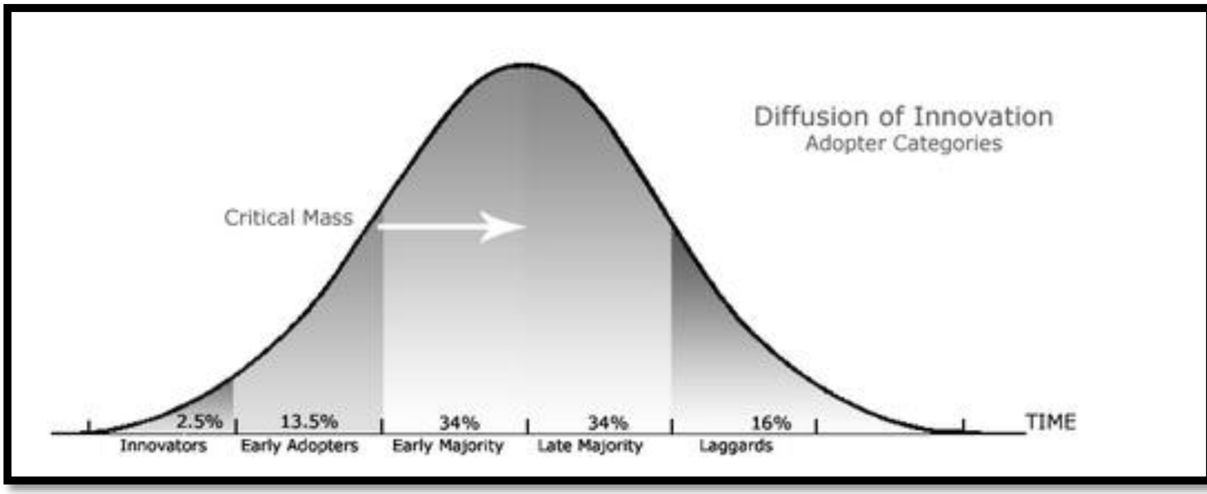

Figure 2.1 Diffusion Theory distribution across category type *(*source*:* Rogers, 1995)

Although Roger's Innovation Diffusion Theory is likely the most influential with respect to timing of the adoption and diffusion of an innovation, there are other theories that apply in the realm of digital instructional technology. The Technology Acceptance Model (TAM) has been used in both educational and business realms to explain acceptance of an adoption of a technology innovation (Ndubisi, 2006). TAM is credited for being highly predictive with regard to acceptance on innovation based on perceived ease of use, which is identified as the degree of effort perceived to be needed to adopt, as well as perceived usefulness, which is the degree an individual believes the innovation will enhance job performance (Davis, 1989). The TAM, introduced in 1989, has been used to explain both the adoption and diffusion of technology innovations when those innovations are deemed to be easy to use and have a high degree of usefulness (Ngai, Poon, & Chan, 2007). Although TAM has been useful in prediction of adoption of innovation, it has also been criticized as not considering individual differences of adopters such as beliefs and attitudes about technology as well as demographic considerations such as prior experience, age and gender (Agarwal & Prasad, 1999). The United Theory of Acceptance and Use of Technology (UTAUT) defined by Venkatesh (Venkatesh, Morris, Davis, & Davis, 2003) takes these additional characteristics into account as moderating factors for intention of use of technology innovations. However, while the TAM has been used as the model for multiple research studies regarding technology innovation adoption, the UTAUT is still considered to be a new model and requires further duplication to be considered valid (Straub, 2009). More recent works such as studies by Bruner & Kumar (2005) and Kim & Forsythe (2008) stress the importance of the consideration of hedonic motives such as enjoyment and engagement as predictors of adoption of technology innovations.

History of Digital Instructional Technology

District technology plans, federally mandated of districts using federal funding combined with theories of adoption and diffusion of technology innovations, as well as institutional theory all help to explain the evolution of digital instructional technology innovations. For decades, the chalkboard and pencil were focal points of all instruction. The chalkboard was the big screen on which teachers provided and directed each step of their lessons. Today, while chalkboards still exist, they are losing their status as a focal point of the classroom and K-12 districts are investing in technology to modernize the classroom experience of the 21st Century digital learner. From interactive whiteboards to handheld tablets, from digital projectors to high-end video systems, the most successful of these technologies are those that promote student engagement and are effectively adopted by educators who maintain a positive perspective about the technology tool (Cengiz Gulek & Demirtas, 2005). Statistics indicate that some students prefer to learn in a visual world and like to have information at their fingertips (Villano, 2006). From the chalkboard invented in the 19th Century to the digital projection of the iPad Air of 2013, many innovations such as these are relevant in current day discourse regarding effective technology adoption in their respective time in history. Although the invention of and the adoption and diffusion of the pencil and its subsequent wide use in schools has spanned nearly 100 years (Szabo, 2002), other technology inventions have not been as readily adopted, diffusion has been sparse and current use is static.

What are the relevant technology innovations of the past and present and, what is the status of adoption and use today for each? Figure 2.2 depicts a chronological history of many of these instructional technology innovations, the technology sophistication level of the device and the current status of the innovations today.

The Learning Machines			
Classroom Technology	**Invented**	**Sophistication Level**	**Current Status**
Magic Lantern	***1870***	***High***	***Replaced***
The magic lantern was the predecessor to the slide machine. It projected images printed on glass plates.			
School Slate	***1890***	***Low***	***Low***
Widely used throughout the 19th century, the school slate was praised for being easily used for repetition.			
Chalkboard	***1890***	***Low***	***Low***
The chalkboard has been a staple in K-12 classrooms from the age of one-room schoolhouses through today.			
Pencils and Paper	***1900***	***Low***	***High***
Mass-produced pencils and paper became more readily available to classrooms.			
Stereoscope	***1905***	***High***	***Replaced***
Three-dimensional viewing devices became popular in schools with educational sets containing images.			
Filmstrip Projector	***1925***	***High***	***Replaced***
With the invention of the filmstrip projector, it was predicted books would become obsolete.			
Radio	***1925***	***High***	***Replaced***
New York City's Board of Education was the first to broadcast lessons to schools via radio.			
Overhead Projector	***1930***	***High***	***Replaced***
First used by military trainers, the overhead projector eventually spread to schools.			
Mimeograph	***1940***	***Medium***	***Replaced***
The mimeograph machine produced copies via a hand-crank mechanism.			
Educational Television	***1958***	***High***	***High***
By the early 1960s more than 50 channels included educational programming in the U.S.			
Hand-held Calculator	***1972***	***High***	***High***
Teachers were slow to adopt calculators for fear they would negatively impact learning of basic math skills.			
Apple Computer	***1977***	***High***	***High***
The first Apple II computer with a floppy disk drive was introduced in 1977.			
PC Computer	***1980***	***High***	***High***
The first PC computer (Plato Computer) was introduced in classrooms in 1980.			
Graphing Calculator	***1885***	***High***	***High***
With the invention of the graphing calculator, Cartesian equations became easier.			
Laser PC5 Computer	***1990***	***High***	***Replaced***
Small 32K RAM laptop computer primarily designed for word processing tasks.			
Newton MessagePad	***1997***	***High***	***Replaced***
Apple's first personal digital assistant with handwriting recognition.			
Interactive Whiteboard	***1999***	***High***	***High***
The interactive whiteboard is used with a digital video projector and computer.			
Windows Tablet	***2002***	***High***	***High***
Microsoft invented the contemporary tablet PC with a digital pen interface.			
Student Response Systems	***2005***	***High***	***Medium***
Known as "clickers", these devices all teachers to poll or quiz students in real time.			
iPad	***2010***	***High***	***High***
The iPad tablet has a user interface built around a multi-touch screen, including a virtual keyboard.			

Figure 2.2 The Learning Machines (source: ("The Learning Machines," 2010))

The sampling of digital instructional technologies above range from relatively- obscure examples (i.e. Newton MessagePad and Laser PC5 Computer) to widely used devices prominent in many American schools (i.e. chalkboard, radio, overhead projectors, and iPads). While each of the aforementioned devices has had or continues to have merits in the classroom and may provide great value to engaging 21st century learners considered digital natives, there exists a quandary regarding a way to calculate cost of ownership and return on investment of such devices. In the ever-changing world of new technologies, these technology innovations may become obsolete all too quickly and schools districts must make hard decisions with respect to the types of technology innovations in which to invest. Acquisition of digital instructional technologies includes up-front expenditures (i.e. hardware, software, infrastructure, devices), as well as ongoing dedicated funding to maintain and update tools and provide professional development for integration and use (Ringstaff & Kelley, 2002). The age of the "build it and they will come" philosophy of equipping classrooms with technology innovations simply to have additional technology available has passed; the decision to adopt any digital instructional technology must be weighed against the cost of the equipment, the lifecycle of the technology innovation and its anticipated benefit to student learning. A method of selecting effective digital instructional technology tools and evaluating their cost effectiveness and academic impact remains a difficult challenge for educators and district leaders.

Funding K-12 Digital Instructional Technology

A report from the Center on Budget and Policy Priorities states at least thirty-four states are now funding student education at a lesser level than before the recession in 2007 (Leachman & Mai, 2013). Concurrently, as funds in these states have decreased, educators are tasked with producing 21st Century ready workers with skills that require mastery of new technologies. The same report confirms the heavy burden of supporting public education rests on state budgets. State funding is the primary course of funding for U.S. public elementary and secondary schools accounting for approximately twenty-five percent of all state budget expenditures, for a total of $260 billion annually nationwide (Leachman & Mai, 2013). The state of Kansas provides funds to local school districts that are directly responsible for paying teacher salaries and other general operating expenses. Local governments are then the other primary funder of the nation's public schools. The federal government pays on average thirteen percent of the total cost of public school education. Thirteen states have cut per student funding by more than ten percent, with Kansas per student funding decreasing by nearly 17% over the past three years, after adjusting for inflation (Leachman & Mai, 2013). Such large cuts in educational spending would seem to limit digital instructional technology innovation and reform efforts. However, school districts continue to find ways to fund the replacement of existing technology, increasing breadth and scope of network infrastructure as well as increasing the foundation level of digital instructional technology in the classroom. School districts have approached the decreased state-appropriated funding of recent years by continuing to fund digital instructional technology initiatives through bond elections for the direct purpose of technology purchases and/or maintenance or through prioritized spending of their decreased budgets whereby technology purchases are of primary importance (Interview, Kansas K-12 School District Business Office Official).

Local school district leaders and policy makers are challenged with developing a framework for thinking about the costs of digital instructional technology initiatives and developing appropriate funding strategies for those plans. The value of this framework could arguably be based on two assumptions: (a) school technology plans will be most efficiently and effectively implemented when all district stakeholders work together to develop appropriate funding strategies; and (b) school districts may need to revise the way in which they budget for technology expenses, differing from past protocol, as needed. Thus, school districts must adopt sound rationale and research all available options while making decisions regarding budgeting for technology expenditures and how they will fund their districts' technology plans (Interview, Kansas K-12 School District Business Office Official).

Digital instructional technology is unlike any other expenditure budgeted by school districts. It is not strictly a labor (e.g., salaries), capital (e.g., equipment), or supply expense (e.g., textbooks, software upgrades). Rather, digital instructional technology is a composite of all of these expenditure types. School districts differ in how they fund technology expenditures. Technology purchases resemble capital expenditures in that they usually requires significant equipment and software start-up costs followed by maintenance costs, but many districts do not fund technology in the same manner as other capital expenses but rather through long-term bonds (Interview, Kansas K-12 School District Business Office Official). Increasingly, districts are funding technology purchases through leasing agreements to evenly distribute technology expenses on an annual basis. Other districts have historically funded technology expenditures exclusively out of the district's general fund.

There are multiple considerations when deciding how to best fund technology acquisitions in schools. First, how to fund the level of capital expenditures needed to install school technology systems in compliance with the district's technology plan must be considered. Second, the funds to sustain the district's technology annual operating costs must be identified. Additionally, funds must be set aside to regularly retire aged-out technologies and replace them with modern technologies. School districts use varying methods to fund initial capital outlays for such technology expenditures: issuing of long-term bonds, scheduling replacement cycles via capital outlay funds, use of general operating funds, or leasing technology equipment (Dickard, 2003).

These and other forms of technology funding frequently are debated by local school boards in an effort to provide technology to classrooms. The best method is often a measure of what works best for the specific school district, its patrons and students. Debated as well are the barriers and benefits to the technology purchased which further fuels the debate as to the learning return on digital instructional technology investments. Using schools’ existing budgeting framework, there is a real danger that staff development and training costs, a significant part of the initial investment and a large component of ongoing costs, will not be funded adequately simply because the framework provides no easy way to cover these expenditures. It is arguably not any district’s intent to have technology deployed in all of its schools only to find that it is not used to its full potential. There is a distinct possibility this situation will prevail if the schools' existing funding mechanism facilitates the deployment of physical capital while constraining the formation of the human capital needed to exploit technology's potential contribution to education (Dickard, 2003). To prevent these problems, school districts will require strong support and assistance from federal and state governments and will need to reform existing school management and budgeting practices. These and other barriers must be considered as part of the complex framework with which to base technology funding decisions (Dickard, 2003).

K-12 Technology Adoption: Challenges and Benefits

Given the amount of money invested in technology purchases, districts are under pressure to ensure the effective use of technologies. District technology coordinators are asked to link technology expenditures to student performance (Lyon, personal communication, 2011). Educators must be careful responding to such pressure. Research on effective instructional models indicates the focus must be placed on learning goals first and then the tools that best meet those goals should be identified (Zimmerman, 2001). Additionally, Earle (2002) suggests that successful technology integration is not defined by the frequency of use but rather by the nature and quality of its use. Hence, becoming a good adopter is more important than a first adopter or a frequent adopter.

Despite the increase in technology funding, more equitable technology access and emphasis on teacher professional development geared toward technology integration, many studies show these measures have not had a significant impact on technology integration in the classroom (Bauer & Kenton, 2005). Although "tech-savvy" teachers in the 2005 research study by Bauer and Kenton were identified as such by their building principals and were highly educated and skilled with technology, they did not in turn integrate technology on a consistent basis as both a teaching and learning tool. Rather, they were better able to overcome obstacles and find ways to be innovative, not necessarily involving technology. One research study indicates that teachers use computers on an almost daily basis but use them effectively only once or twice a year for high-level instructional purposes (Russell, Bebell, O'Dwyer, & O'Connor, 2003). This calls for a closer examination of why there may be a gap between effective classroom professional and instructional uses of technology. Why is it that so many teachers may be efficient at using technology for professional productivity but rarely strive to find meaningful ways to implement technology effectively as an instructional tool? This further highlights the multiple challenges as well as opportunities for positive impact educational technologies have when adopted and diffused throughout a school system. The importance of overcoming barriers to impact student achievement remains one of the most critically important components of the infusion of spending on digital instructional technology tools and innovations. There are multiple barriers as well as benefits to the adoption of digital instructional technology innovations. This section discusses factors impacting both the teacher and student.

Several common attributes may be considered in the effective planning of and implementation of integrating technology into the curriculum including: teacher attitudes toward technology, teacher knowledge about technology, teacher preparation and professional development, teacher mentoring, and teaching instruction and implementation in the classroom (Archer, 1998). These attributes allow teachers to focus on pedagogy and not technology. Teachers may often find themselves in the role of "student" as many teachers rely on students to instruct them on the use of technology. This may cause some teachers to shy away from gaining new knowledge as they are uncomfortable with not being as technology proficient as their students are (Bowman, 2004). Thus, ironically, a teacher's attitude regarding technology may be a driving force that actually prevents them from learning the technology that would, in the end, change their attitude toward technology.

In his book "Crossing the Chasm," Geoffrey Moore (Moore, 2002) reveals the theory of the Technology Adoption Lifecycle which focuses on a version of Roger's Diffusion of Innovation Theory. Within this bell curve depicted in Figure 2.3, there exists a chasm where technology purchased, but not effectively implemented, often ends up stored on a shelf. Moore states that if this chasm isn't crossed, innovative technology implementations often fail. Thus, the importance of teacher buy-in, adoption and diffusion of technology is highly correlated to the effectiveness and sustainability of the success of any digital instructional technology implementation (Moore, 2002).

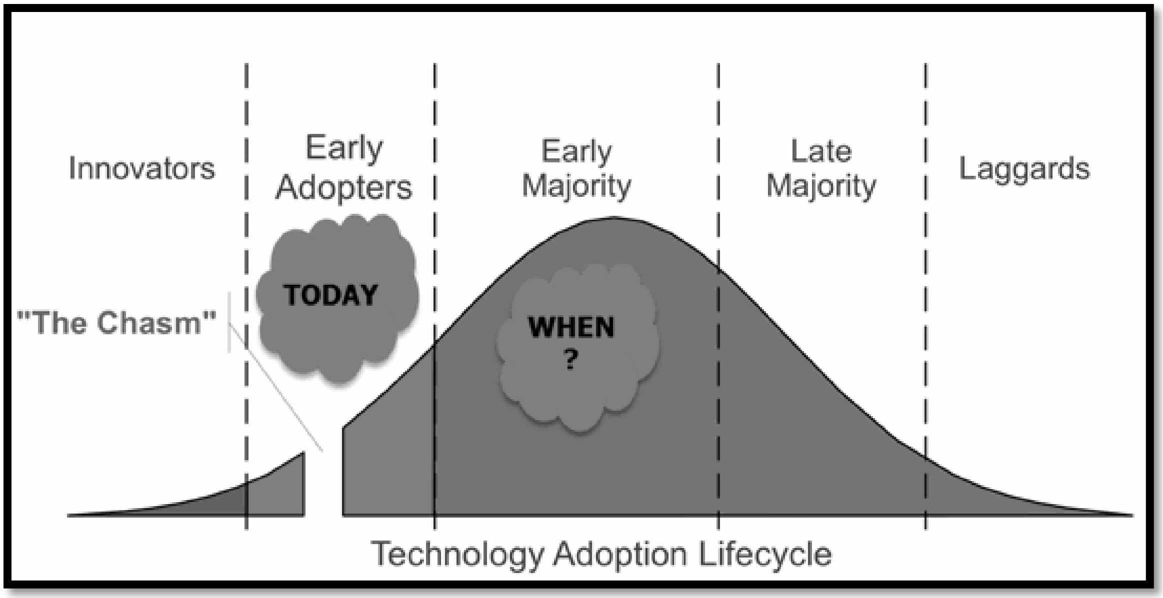

Figure 2.3 Technology Adoption Lifecycle *(*source: Moore, 2002)

Arguably, 21st century high school students have developed a markedly different preference toward the type of delivery of instruction based on their experiences and interactions with technology outside of the classroom. In their article, "Teaching the Virtual Generation," Proserpio & Gioia (2007) argue that students are raised in an environment dominated by visual images and interactive media. Thus, they suggest that these students have a markedly different preference for content delivery which is often mismatched with the learning environment in which they are placed. Proserpio and Gioia (2007) also argue that teachers' delivery mode has held consistent over many generations, and needs to change to match the changing medium preferred by any given generation of students. Changing access to technology for all socio-economic groups as well as integration of technology into the social arena also modify the implications for teaching and learning pedagogies. Although there has been increased awareness regarding the benefits of technology integration in areas such as: student engagement, motivation and performance, and, multiple professional development opportunities for educators to prepare them for technology integration at every level, there remains a disconnect with educators regarding the rationale and personal motivation for becoming technology proficient and integrating technology in their individual classrooms (Proserpio & Gioia, 2007).

Administrative support for teacher technology training is often lacking and thus the influence of the school structure and climate may often be a barrier to technology implementation. Järvelä (2001) describes a typical scenario where teachers who were anxious to implement technology in the classroom were "not provided with common planning time, not provided with release time, and were not provided with stipends." The lack of support in the school climate and structure often dictates the level of technology proficiency as well as the level of technology integration in many schools and districts today.

Professional development for technology integration often falls short in schools and does not provide time on the teaching strategies needed to effectively implement technology (US Congress Office of Technology Assessment, 1995). The same OTA study found that when teacher technology proficiency increases, the level of teacher anxiety decreases and positive attitudes toward technology integration increases. Teachers need the time to experiment with new technologies, to share these experiences with other teachers, to prepare lessons using the technology and to have the time to attend professional development outside of the classroom day (Byrom, 1998). They need time to transfer their knowledge and skills learned into integration of that knowledge in the classroom. Further, technology training at the building level often focuses on how to use equipment rather than how to integrate technology into the curriculum. Morris (2002) concurs and argues that necessary resources for effective technology integration include: adequate access to technology; technical and pedagogical support; professional development that allocates time and resources for follow-up training; and, mentoring support from colleagues as well as time to explore new technologies.

The presence of highly technology-proficient teachers as well as high availability of digital instructional technology does not guarantee the effective integration of technology in the classroom. Tang and Austin (2009) suggest students' attitudes toward the use of technology differs as the level of interaction with the instructor differs. Students who expected a technology-rich course to be more interesting and enjoyable found it to be true only as the level of interaction with the instructor was also high. In other words, the teacher's ability to interact both with technology as well as with the students greatly determined the students' enjoyment of the course. The same study points to the fact that technology integration may not only have positive impacts on teaching and learning but also negative ones. If technological problems occur or a teacher's inability to adapt to technological problems exists, students may become impatient and begin to prefer to be taught in a more traditional manner. Thus, the authors concur that it is not the technology that contributes to level of effective learning but rather the implementation and integration of technology that does so.

Every instance of using digital instructional technology in the classroom does not necessarily positively impact student learning. Students may be engaged by technology use by teachers more so than the teacher's command of subject matter. Research on this differentiation indicates that students may evaluate a teacher more on their "communication competency" (i.e., use of technology) rather than their "task competency" (i.e., knowledge of subject matter) (Webster & Hackley, 1997). Byrom (1998) suggests that the need for keeping abreast of technology changes is often not communicated to teachers. Thus, they do not understand fully how their effective use of technology could benefit students. Lumpe, Czerniak, Haney & Beltyukova (2012) argued that teacher beliefs become pivotal factors in reform decisions and impact the implementation of technology in the classroom. The authors further contend if teachers' attitudes are not positive, the value of technology on student engagement and motivation is limited. Thus, student engagement and motivation is impacted directly by a teacher's comfort level with technology, understanding of the importance of technology and realization of the impact technology may have on students.

A current dialogue in education touts the importance of so-termed "21st Century Skills" to prepare learners for their future after high school, whether that be college or career. Specific skills to prepare students as citizens in an increasingly global and technology-driven 21st century, which have increasingly been emphasized in schools since the introduction No Child Left Behind, include critical thinking skills, decision-making, cooperative group working, problem solving, experiential learning, and real-world interactions (Groff & Mouza, 2008; Ravitch, 2009). A criticism of schools' increasing emphasis on 21st century skills comes when traditional content knowledge and skills have become obsolete, replaced by functional skills and preparation for one's 'future' without regard for the historical past (Ravitch, 2009). This discussion of 21st century skills connects to the understanding of digital instructional technologies in classrooms. Proponents of digital instructional technology promote building technology literacy and computer-based skills as necessary for one's success as a learner and future adult in society. Technology remains a viable instructional tool to accomplish the academic aims of thinking critically, comparing, contrasting, and synthesizing what one has learned. In conjunction with subject matter content, digital instructional technology can elevate learning to an interactive platform and simultaneously prepare 21st century learners, yet it alone cannot become a singular vehicle or and end all of its own.

Technology is not in and of itself directly tested or attached to other curricular area testing, the identification of technology integration as a focus area for school improvement is often lost to curricular-related areas for targeting improvement. Multiple studies have tested the effect of technology integration on student performance with results varied. Tests as simple as studying the effect of PowerPoint presentations in class on student performance indicate there is no significant effect in terms of student performance (Rankin & Hoaas, 2001). An additional study found students who were not prior enthusiasts of technology admitted to a change in attitude toward technology and found class more interesting when high technology integration was implemented at mid-year (Alexiou-Ray, Wilson, Wright, & Peirano, 2003). Some studies also attributed achievement to motivational effects of technology on students in the classroom (Weimer, 2001). Additional research suggests that all students, including at-risk students, have the potential to see a positive change in student classroom grades, GPA and attendance, if technology is effectively implemented in the curriculum (Means, 1994). Other more recent studies (Digregorio & Sobel-Lojeski, 2009) suggest that technology integration via use of Interactive White Boards positively impacts student motivation and interest. Starbek, Erjavect and Peklaj (2010) found that students acquired greater knowledge and improved their comprehension skills by learning from a computer-based instructional mode versus either a traditional lecture format or a reading format.

Conversely, recent research has suggested a potentially-negative impact on student math and reading test scores when access to home computer technologies was increased dependent on parental supervision, underscoring the fundamental principle that technology alone is not enough to enhance learning (Vigdor & Ladd, 2010). Likewise, in a synthesis of research on elementary math instructional best practices, Slavin and Lake (2008) suggest that all student subgroups, particularly those from a low socioeconomic background, benefit from a more traditional curriculum structure and traditional instructional methods, not methods heavily infused with instructional technology. These studies combined underscore the nuances of digital instructional technology and how it has potential, yet not assured, capacity to enhance student learning. To access the potential benefits and minimize the potential challenges of digital instructional technology, it must work in conjunction with other factors such as effective leadership, new instructional practices and the use of assessment data to individualize learning in order to address broad educational challenges faced by teachers and students alike (Starbek et al., 2010).

Research Questions

Research on K-12 digital instructional technology explores the use of technology in classrooms, varying theories regarding factors affecting teacher decisions to integrate technology, as well as recent district-wide adoptions of new technologies and their impact on student achievement. However, based on the literature reviewed there appears to be a gap in the literature within a defined historical timeframe regarding digital instructional technology adoptions within a single district, to examine why certain technologies persist while others do not and how digital instructional technology has evolved in a single district over the same time.

Thus, with the continued availability of new and innovative digital instructional technology tools and the importance of making prudent adoption decisions of such technologies, the following research questions will guide this study:

1. How has digital instructional technology evolved over the past thirty years in one district?
2. What have been the key factors influencing a district's adoption or non-adoption of digital instructional technology innovations?
3. To what extent do teachers use available digital instructional technology?

4. What factors influence a teacher’s decision to use available digital instructional technology?
5. What are the perceived benefits of the various digital instructional technologies adopted according to teachers?

Chapter Three

Methods

Research Design and Rationale

The purpose of this study was to address the overarching question: *How has digital instructional technology evolved over time in a large suburban Kansas school district and what has influenced its adoption and use/nonuse?* A case study method was utilized to investigate these areas within the chosen district over thirty years, 1984-2014. Merriam (2009) suggests this methodology to be suitable for this type of research as it is directly related to understanding how people make sense out of their lives within a bounded system, outline the practices used to attribute that meaning, and describe how people interpret their experiences. Merriam further provides the following key characteristics of case study research. Case studies: a) have a focus on meaning and understanding, b) use the researcher as the primary instrument, c) involve an inductive process, and d) rich description (Merriam, p. 40). Patton (1985) describes qualitative research as purposefully studying the specific to better understand the general. In inductive reasoning, the researcher begins with specific observations, then measures and seeks to detect patterns and symmetries. This is done in an effort to formulate suppositions that can be further explored. Finally the developments of general conclusions or theories can be surmised in an effort to inform further research or study.

Merriam (2009) points out the case study methodology is chiefly useful for studying educational innovations, evaluating programs or implementations, and informing policy. These are the defined goals of this dissertation and were thus chosen as the appropriate methodology. This case study involves a specific entity – a suburban Kanas school district – involved in a contemporary context surrounding debate over technology expenditures, adoptions and diffusion of innovation (the case). The results of this case study were explored in depth for the purpose of understanding the evolution of digital instructional technology, factors influencing the evolution of the technologies, and identifying its challenges and benefits through the perception of effectiveness by teachers in the district.

Data Collection

One of the key features of the case study format is collection of data from multiple sources to explore and report on the phenomenon through the use of interviews, surveys, field observations and/or document content analysis (Merriam, 2009). For this dissertation, I collected data from four sources in order to address the five research questions:

a) review and analysis of historical documents and digital data regarding digital instructional technology adoptions and expenditures from 1984 to 2014, and their funding source,
b) interviews with eight district-level staff who would have influenced technology purchasing, adoption and integration strategies in the district over the past thirty years: six technology coordinators, facilitators and directors as well as two past and present district chief business officers,
c) survey of all current certified staff at the elementary, middle and high school levels who have been employed with the chosen district for at least twenty-five years during the thirty year timeframe, and
d) interviews with selected certified staff at the elementary, middle and high school levels based on responses to the teacher survey. Two teachers from both the middle and high school level were interviewed and three teachers from the elementary level were interviewed.

The data collection methods were used to answer the research questions of this study:

1. How has digital instructional technology evolved over the past thirty years in one district?
2. What have been the key factors influencing a district's adoption or non-adoption of digital instructional technology innovations?
3. To what extent do teachers use available digital instructional technology?
4. What factors influence a teacher's decision to use available digital instructional technology?
5. What are the perceived benefits of the various digital instructional technologies adopted according to teachers?

Sample. The district chosen for this case study is a suburban school district in Kansas. The student population of the school district is approximately 30,000. There are approximately 2,600 certified teachers and approximately 120 total district-level and building-level administrators in the district. Teachers selected for the teacher survey were those who have been employed with the district for at least twenty-five years (165 staff); two teachers from each level (elementary, middle and high) were subsequently selected for a follow-up interview that resulted in a selection of six teachers. An additional teacher was selected for a follow-up interview at the elementary level after analysis of the survey results, resulting in seven total teachers interviewed. Technology facilitators, coordinators and directors past and present provided the researcher with a population of six staff for the technology-leader interview. One former district business office director and the current Chief Financial Officer (CFO) were also interviewed. The interviews were conducted after approval was obtained by the dissertation proposal committee and the University of Kansas Human Subjects Committee of Lawrence (HSCL). To protect anonymity, interview participants are referred to using the pseudonyms depicted in Table 3.1. Technology staff are denoted with the code "TECH." Business staff are represented by "BUS." Teacher interview participants are categorized as elementary teacher (ELEM), middle school teacher (MIDDLE), and high school teacher (HIGH).

Table 3.1
Interview Participants by District Role

Technology Staff	Business Staff	Teachers
TECH1	BUS1	ELEM1
TECH2	BUS2	ELEM2
TECH3		ELEM3
TECH4		MIDDLE1
TECH5		MIDDLE2
TECH6		HIGH1
		HIGH2

Historical Data: Digital Instructional Technology Expenditures and Funding Source. The historical archived documents and digital data collected regarding digital instructional technology adoption decisions, expenditures and origin of funding source were directly associated to research question one. Available data for expenditures on digital instructional technology innovations over the past thirty years were collected and analyzed to understand patterns of district expenditures and funding sources. Administrative documents and data collected was comprised of Board of Education reports and minutes, historical bond information and bond reports, expenditures allocated for technology, newspaper articles and purchase order history. These documents include the following documents types and are coded in subsequent chapters using the acronyms provided as follows for each document type, followed by the year of the document storage container: Board of Education Summary Reports (BOESR) 1984-2014, Business Office Technology Bond Election Records (BOND) 1985 - 2014, Technology Advisory Committee Records (TACR) 1993-1994, Technology Task Force Records

(TTFR) 1997, Bond Task Force Records (BTFR) 2006-2007, Technology and Learning Implementation Plan (TLIP) 2005-2010, personal correspondence and paper and digital records of technology leaders 1984-2014, and the KSDE Approved Technology Plans (KSDETP) 1984 - 2014. These historical documents are referenced throughout Chapter Four and Chapter Five and were retrieved by the researcher from the document archives in the basement storage filing cabinets at the district administrative central board office and closely examined. Board Data related to digital instructional technology implementations in the district is presented in each of the three researcher-defined eras: the beginning years (1984-1993), model schools era (1994-2003), digital classroom era (2004-2014). This historical data is used to provide a rich description of the details surrounding the evolution of digital instructional technology in this district over a period of thirty years. Analysis is focused on the overall goal of the district during each of the eras.

Interviews with District-Level Technology Staff and Business Officials. The goal of the district-level staff interview instruments was to address the *first and second* research questions of this study:

1. How has digital instructional technology evolved over the past thirty years in one district?
2. What have been the key factors influencing a district's adoption or non-adoption of digital instructional technology innovations?

Interviews were conducted in person in each participant's individual office location. The interview format used was a semi-structured format, utilizing a predetermined set of questions (Appendices A and B) to guide the interview. Interview participants were provided and signed the HSCL-approved interview document (Appendix C). Responses are kept anonymous in this study by referencing the participants' general position only and interview participant number. The duration of each interview was approximately sixty minutes.

Analysis of District Staff Interviews. Each interview was audio recorded, transcribed, and analyzed using MS Word and MS Excel. The data was used to provide additional rich descriptive information to address research question one. It was also analyzed in phases using a rich description of the trends, frequency and commonality of themes in the transcribed data to address research question two.

Phase One – Transcription. Interviews were transcribed using MS Word. Each interview was reviewed multiple times to ensure accuracy of transcription. Additionally, this method allowed the researcher to listen for voice inflections and tone of the conversation.

Phase Two – Analysis. Each interview was analyzed and coded by establishing general themes and categories. Themes were color-coded to assist in identifying frequency of theme. The transcriptions and coded documents were provided to each interview participant to check for accuracy and requests for modification and to ensure respondent validity (Merriam, 2009). This ensured the transcription and themes were captured accurately and provided validity in the identification of the general themes. The themes were constructed and derived so as to assist with answering research question two.

Phase Three – Tabling of Data. Taking the identified themes from the interviews, a MS Excel table was then used with the general themes for row headings; the participants' initials and district role code established the column headings; and examples of content from each interview completed the matrix. Creating a table in this fashion assisted in ensuring the themes selected were exhaustive (all data has a place) and were mutually exclusive (all data fits in only one theme).

Phase Four – Condensing and Revising. Following the compilation of all categories and sample responses in phase three, each theme and its relationship to other themes was studied and reduced in an effort to reduce the number of themes. This was done with the goal of retaining accuracy and no loss of content meaning.

Phase Five – Analysis of District Staff Interviews. Once the interviews were completed, the final data was described using a rich description of the trends, frequency and commonality of themes in the transcribed and charted data from the interviews.

Teacher Survey. The goal of the teacher survey instrument was to address the *third, fourth, and fifth* research questions of this study:

3. *To what extent do teachers use available digital instructional technology?*
4. *What factors influence a teacher's decision to use available* digital instructional *technology?*
5. *What are the perceived benefits of the various digital instructional technologies adopted according to teachers?*

The survey instrument (Appendix D) was created using Qualtrics, a web-based survey tool used to create, distribute and assist with analyzing and reporting data. The questions on the survey instrument were directly associated to research questions three through five and addressed factors influencing teacher use of available educational technology and teacher perception surrounding effectiveness of educational technology. Questions were developed by the researcher in order to better understanding how veteran teachers who have been employed with the chosen district for at least twenty-five years used digital instructional technology over the timeframe of this study, 1984-2014, and the factors that have influenced their decisions.

In order to distribute the survey instrument, a survey link was emailed to 165 district staff email addresses for simplicity, with prior approval from the Superintendent's office. The 165 staff targeted were those who were currently employed with the district during the 2013-14 school year and had been employed with the district for at least twenty-five years. Distributing the survey via email eliminated the cost, time and errors involved in transcription of the data, while maintaining confidentiality of the data. Prior to distribution of the survey link via email to the participating teachers, an explanatory introduction email was sent describing the purpose and nature of the study. The initial email and HSCL survey statement (Appendices E and F) were sent following approval by the dissertation proposal committee and the University of Kansas Human Subjects Committee of Lawrence (HSCL). The survey instrument was sent in May, 2014, requesting responses within two-weeks. A reminder email was sent seven days into the survey window. The targeted response rate was thirty percent to achieve approximately fifty participants with near equal representation at all three levels. The survey was expected to take approximately fifteen minutes to complete.

Data Analysis of Teacher Survey. Once the surveys were completed, preliminary analysis of data utilizing the analysis features in ***Qualtrics*** as well as analysis and comparative charting in MS Excel was done. Data was disaggregated by level (e.g. high school, middle school, elementary) and by grade or curricular area. The data was also analyzed separately with respect to devices categorized by use in three identified separate eras: the beginning years (1984-1993), model schools era (1994-2003), digital classroom era (2004-2014). These researcher-defined eras were established based on the baseline period when digital instructional technology began to be introduced into the district's classrooms and the timing of the initial implementation of digital classrooms in the district. Quantitative and descriptive data is reported regarding survey response rates, representativeness and responses to Likert scale questions.

Interviews with Teachers. Seven teachers (two from the middle school level, two from the high school level, three from the elementary school level) were identified for subsequent interviews, following the approved interview guide (Appendix G). The third elementary teacher was selected after an analysis of responses by those agreeing to an interview. The third teacher selected had provided negative responses with respect to beliefs about instructional technology and her perspective was desired. The goal of the proposed teacher interview questions was to address the *third, fourth, and fifth* research questions:

3. *To what extent do teachers use available digital instructional technology?*
4. *What factors influence a teacher's decision to use available digital instructional technology?*
5. *What are the perceived benefits of the various digital instructional technologies adopted according to teachers?*

The questions used in the interviews were associated with research questions three through five and address factors influencing teacher use of available digital instructional technology and teacher perception surrounding benefits of adopted use of digital instructional technology. Questions were developed by the researcher in order to gain an understanding of how veteran teachers who have been employed with the chosen district have used digital instructional technology over the timeframe of this study, 1984-2014, and the factors that have influenced their decisions.

Interviews were conducted in person at a location chosen by the participant. The interview format was a semi-structured format, utilizing a predetermined set of questions to guide the interview. Responses are kept anonymous in this study by referencing the participants' general position only. The duration of each interview was approximately forty-five to sixty minutes. Each interview was audio-recorded, transcribed and subsequently analyzed.

Data Analysis of Teacher Interviews.

***Phase One – Transcription*.** Interviews were transcribed using MS Word. Each interview was reviewed multiple times to ensure accuracy of transcription. Additionally, this method allowed the researcher to listen for voice inflections and tone of the conversation.

***Phase Two – Analysis*.** Each interview was analyzed and coded by establishing general themes and categories. Themes were color-coded to assist in identifying frequency of theme. The transcriptions and coded documents was provided to each interview participant to check for accuracy and requests for modification and to ensure respondent validity (Merriam, 2009). This ensured the transcription and themes were captured accurately and provide validity in the identification of the general themes. The themes were constructed and derived so as to assist with answering the proposed research questions.

***Phase Three – Tabling of Data*.** Taking the identified themes from the interviews, a MS Excel table was used with the general themes for row headings; the participants' initials and district role code established the column headings; and examples of content from each interview completed the matrix. Creating a table in this fashion assisted in ensuring the themes selected were exhaustive (all data has a place) and were mutually exclusive (all data fits in only one theme).

***Phase Four – Condensing and Revising*.** Following the compilation of all categories and sample responses in phase three, each theme and its relationship to other themes was studied and reduced in an effort to reduce the number of themes.   This was done with the goal of retaining accuracy and no loss of content meaning.

***Phase Five – Analysis of Interview Data*.** Once the interviews were completed, the final data was described using a rich description of the trends, frequency and commonality of themes in the transcribed and charted data from the interviews. The data was analyzed separately with respect to digital instructional technology and its use, categorized in three identified eras: the beginning years (1984-1993), model schools era (1994-2003), digital classroom era (2004-2014).

Descriptive Analysis of Survey and Interview Participants. A descriptive analysis of survey and interview participants and rates of completion, and a descriptive analysis of the historical documents are provided in this section. This data is provided a basis for providing a description of those providing interview responses as they are used to substantiate the historical record of the district's adoption of digital instructional technology during each researcher-defined era providing in Chapter Four. An in-depth review and analysis of the historical documents is used to provide sequential historical documentation portraying the evolution of digital instructional technology in this district over a thirty year timeframe and provides the primary focus of Chapter Four's findings articulated in research questions number one and two. Subsequently, Chapter Five addresses research questions numbers three, four, and five concerning teacher's perceptions about technology adoption and use and is informed by interview data and survey results.

Descriptive Analysis of Data

Descriptive Survey Data. Data were collected from veteran teachers having taught in the chosen district for a period of at least twenty-five years. Survey participants [n=165[6]] were

[6] There were 165 certified teachers who had taught in the chosen district for at least 25 years.

sent an email containing the digital link to the teacher survey instrument on June 16, 2014. One week later, a reminder email was sent requesting participation in the survey. At the end of a two week timeframe, sixty-five teachers (thirty-nine percent) had participated in the survey answering 83% of the questions. Fifty-four teachers (thirty-three percent) completed the survey in its entirety, answering 100% of the questions. For each question answered, the sample N is provided. Demographic data of survey respondents was disaggregated and is depicted in the tables below. The majority of teachers responding were female teachers. Ninety-four percent of those responding had earned a Master's Degree; and ninety-eight percent of the teachers responding had taught over twenty-five years in this district. The teaching assignment for respondents was relatively equally divided between elementary, middle and high school – with elementary teachers comprising the majority of respondents.

Gender of Survey Respondents

		Response	%
Male		17	26%
Female		48	74%

Level of Education of Respondents

		Response	%
Bachelor's Degree		3	5%
Master's Degree		61	94%
Doctoral Degree		1	2%

Teaching Experience

		Response	%
20 - 25 years		1	2%
26 - 30 years		23	35%
>30 years		41	63%

Grade Level

		Response	%
Elementary		26	40%
Middle School		14	22%
High School		22	34%
Other (Alternative, Early Childhood, etc.)		3	5%

N = 65

Figure 4.1 Characteristics of Teacher Survey Participants

The teaching assignment of respondents is shown in Figure 4.2. The majority of respondents were grade level classroom teachers followed next by middle and high school non-core subject area teachers. Middle and high school STEM teachers (science, technology, engineering and mathematics) and middle and high school humanities teachers were the next two largest respondent groups.

Grade/Curricular Area Assignment

Answer		Response	%
MS or HS Humanities: (Language Arts/Reading, Psych, Soc Science)		7	11%
MS or HS Other Non-Core Subject Area: (Fine Arts, Physical Education, FACS, etc.)		15	23%
Elementary Classroom Teacher (Grade Level Teacher)		21	32%
Elementary Subject-Specific Teacher (Physical Education, Fine Arts, etc.)		2	3%
MS or HS STEM (Science, Technology, Engineering, Mathematics)		10	15%
MS or HS Special Education Teacher		3	5%
Elementary Special Education Teacher		2	3%
Other		5	8%

N = 65

Figure 4.2 Teaching Assignments of Teacher Survey Participants

The goal for participant response was at least thirty percent which was met with sixty-five participants responding to the survey. As the chart above depicts, all three levels (elementary, middle and high school) are nearly equally represented in the survey results.

Descriptive Interview Data.

Teacher Interviews. The response to the last survey question indicated fourteen of the sixty-five responding teachers were willing to be contacted for a follow-up interview. The goal stated in Chapter Three was to identify two teachers from each of the three levels (elementary, middle and high school). I randomly selected two high school teachers and two elementary teachers from those indicating their willingness to participate in a follow-up interview. There were only two teachers from the middle school level who indicated a willingness to participate and thus, they were selected. Upon assessing the answers to the survey questions in greater detail, a third elementary teacher was selected to participate in a follow-up interview. This teacher's survey responses denoted negative beliefs and perceptions about the effectiveness of digital instructional technology on teaching and learning. Thus, her opinions were included to provide a more comprehensive portrayal of teacher attitudes.

District-Level Technology Staff Interviews. Six current and past district-level technology leaders were identified who had leadership and decision-making roles during the timeframe 1984 to 2014 with respect to decisions related to digital instructional technology expenditures, placement of technology in classrooms, and/or teacher training and professional development. These six technology leaders were asked via email to participate in an interview to describe their recollection and participation in the evolution of digital instructional technology using the interview guide approved by the University of Kansas HSCL department. All six requests for an interview were granted. With the interviews scheduled, I conducted the interviews in-person in a mutually agreed upon location.

District-Level Business Official Interviews**.** Two current and past district-level business officials were identified who had leadership and decision-making roles during the timeframe 1984 to 2014 with respect to the funding source and purchasing of digital instructional technology. These two business officials were then asked via email to participate in an interview to describe their recollection and participation in the selection, funding and purchasing of digital instructional technology during the timeframe 1984 to 2014. With the interviews scheduled, I conducted the interviews in person in a mutually agreed upon location.

Descriptive Historical Data. The historical documents were reviewed and analyzed prior to completing all interviews so as to gain background knowledge regarding the history of digital instructional technology from 1984 to 2014. They were subsequently revisited after completion of the interviews to fill in gaps of knowledge from interviewee responses and to substantiate and clarify information gained throughout the interview process.

Together, the findings of the survey data, interview data and historical data were analyzed to address the five research questions.

Final Analysis

In the final phase of analysis of all data, the researcher provided a detailed description of patterns, trends, and themes found between and among all of the data sources with the goal of addressing the questions related to this research study and to describe in descriptive detail the story of how digital instructional technology has evolved in this district over the past thirty years. The totality of the data was interpreted to construct meaning and benefit this district as well as to inform policy practices in the future.

Researcher's Role

It is important to note the researcher's role in the district chosen for this study. The researcher was the Director of Instructional Technology for the district during the timeframe of 2013 to present (2015). The researcher did not play a decision-making role in the thirty year timeframe studied. The researcher's access to staff and their subsequent willingness to be forthright with the researcher was determined to be a positive aspect as it lent itself to information not available to most outside the technology division or outside district leadership.

Chapter Four

History: Findings and Data Analysis

This study sought to richly describe the evolution of digital instructional technology and to identify and provide an analysis of the key factors and influences that have played a role in the evolution of digital instructional technology in a large suburban Kansas school district over a period of thirty years. It describes the factors that lead to the district's selection and adoption of digital instructional technology from 1984 to 2014. In addition, the study describes the extent to which teachers have used the available technologies, factors influencing their decision to use these technologies and the perceived benefits from their use. This case study used a larger Kansas suburban school district as the focus of the study, with data collection including historical records related to digital technology expenditures and implementations, surveys of veteran teachers having taught in the district for at least twenty-five years and interviews of teachers, technology leaders and chief business officials. Triangulation of data (historical data and documents, surveys and interviews) was used to provide validity to the analysis of the data. Merriam (2009) stresses reliability is enhanced in a qualitative study through triangulation of data across multiple sources of data.

In this chapter, I present the study's findings based on the collected data pertaining to the history of digital instructional technology adoption over a period of thirty years. The focus of Chapter Four's findings are articulated in research questions number one and two.

Research Question #1: Evolution of digital instructional technology 1984-2014

Archived historical data and physical documents from the district's storage depository and obtained from past and present district staff were merged with descriptive interview data from district technology and business staff. The combination of both sources of data was used to address research question #1:

1) *How has digital instructional technology evolved over the past thirty years in one district?*

In this section I provide a rich and sequential detailed description of the evolution of digital instructional technology in the chosen district in three researcher-identified distinct eras: the beginning years (1984-1993), the model schools era (1994-2003), and the digital classroom era (2004-2014). During each era I describe the digital instructional technology adopted and, where possible or meaningful to the study, I describe the cost to the district and the funding source. This detail is provided to establish a more in-depth understanding as to the magnitude of decisions for adoption/non-adoption by district leaders as well as for veteran teachers.

1984-1993: The Beginning Years. Prior to 1984, this school district had just begun to discuss digital instructional technology in the classroom through the establishment of a computer education steering committee comprised of three teachers, one librarian, two principals and two district administrators. At that time, there were no microcomputers in the classrooms across the district. A report commissioned by IBM and used by the district in 1981 (Blasch, 1981) assisted the district with beginning to frame the concept of digital instructional technology and its implications in the classroom. The focus of the Blasch report was on three instructional computing objectives established by IBM Corporation: 1) computer literacy, 2) problem solving, and 3) computer aided instruction (CAI). The IBM report underscored the importance of the computer as a means for providing reinforcement (drill and practice) activities and personalizing lesson feedback for students. In 1982, the steering committee, led by the district's assistant superintendent, began to investigate what other districts were doing with respect to placing computers in the classroom. At that time, there were fifteen school districts in Kansas who were contacted for information in an effort to solicit information to assist with the district's decision regarding a future recommendation to the Board of Education. Multiple school districts in Kansas and Nebraska had placed both Apple computers and Radio Shack TRS-80 model computers in their classrooms (Memorandum to the Superintendent, Jan 20, 1982). The recommendation from the steering committee to the superintendent, after feedback from personal contact by the assistant superintendent with eight school districts, was to place stand-alone Apple computers in the district's classrooms and consider the TRS-80 stand-alone computer for computer programming courses at the high school level. The rationale for the technology selection provided by the committee was multifaceted: educational software availability for the Apple computer, ease of expansion, adaptability for use in all academic areas and utilization of color as an engagement factor for students used as an instructional tool. In addition, evaluation of available literature on microcomputer software was also used as a basis for the recommendation. Following the decision, the computer steering committee's work expanded to establish goals and needs statements to guide the district. The committee established the following as the guideline for the district's philosophy regarding computer education: *In preparation for life in this technological age, the district recognizes a shared responsibility to develop educational opportunities for computer awareness and computer literacy.*

Subsequently, during the 1982-83 school year, the district established a foundational number of Apple computers and Radio Shack TRS-80 computers at the then fourteen elementary schools, three junior high schools and two high schools in the district. One Apple II computer was placed in each elementary building, five Apple II computers were placed in each junior high school building and seven Apple II computers and eight TRS-80 computers were placed in each senior high school building. The goal was to add on additional computers based on a review and analysis of impact each year. The curriculum focus at each level was basic computer literacy and computer awareness at the elementary level. At the junior high level the emphasis of use was on remedial instruction in mathematics. The senior high focus of use revolved around three components: computer programming via student use of the TRS-80 model computers, supplemental use of the microcomputer in science courses, and math remediation skills.

The stated goal of the steering committee report was to add on approximately thirty-five computers district-wide each year for five years so that before the 1990 school year began sufficient units existed at each level to allow the microcomputer to be utilized as a major instructional support tool in all curricular areas. The report underscored the importance of establishing this infrastructure gradually—keeping in mind the importance of staff training, equipment additions and further assessment of viable computer utilization in all curricular areas. Thus, the goal was to have approximately 225 computers district-wide in classrooms by the 1990 school year at a cost of approximately $272,000 over six years[7] (TACR, 1982). The initial goal of digital instructional technology adoption centered on equity across the district in sheer number of devices. A technology need was not driving the adoption but rather the plan put in place by the district's steering committee was directing placement of digital instructional technology across the district. Drawing from Technology Task Force records and steering committee documents, the district's plan was to fund this initiative primarily with available capital outlay funds on a yearly basis. This amount, however, would prove to be insufficient as additional computers were added each year above what was anticipated; by the 1987-88 school year, the

[7] Administrative documents cited in this chapter are coded as follows, and include the year of the storage container in which they reside in archived storage: *Board of Education Summary Reports* (BOESR), *Business Office Technology Bond Election Records* (BOND), *Technology Advisory Committee Records* (TACR), *Technology Task Force Records* (TTFR), *Bond Task Force Records* (BTFR), *Technology and Learning Implementation Plan* (TLIP), and *KSDE Approved Technology Plan* (KSDETP).

two high schools had sixty-eight and fifty-two Apple II (both Apple IIe and the newer model Apple IIgs) computers and each of the four junior high schools had approximately thirty-three Apple II computers. The sixteen elementary buildings at that time had a varied number of Apple II computers (nine to twenty-four) depending on student population in the school. The total number of computers district-wide at the start of the 1987-88 school year [Apple (IIe and IIgs), Tandy (TRS-80), and IBM (PS/2)] was 675. The computer expenditures during the 1987-88 school year alone amounted to an additional $266,466 (BOESR, 1988). It should be noted that all funding of technology purchases for existing classrooms were funded via capital outlay funds and general operating funds prior to the 1994 bond election. As new school buildings opened, the cost of technology purchases and related equipment for new schools was funded by the appropriate bond election funds for each new school. One technology leader interviewed described the use of the Apple IIe and IIgs computers as being mostly used for computer-aided instruction. She stated, “We used these computers primarily with 5.25-inch and later 3.5-inch floppy disks from MECC – that was the Minnesota Educational Computing Consortium. Students played little math or social studies games on them, like Oregon Trail. Teachers weren’t quite sure what else to do with them at first really,” (TECH6). The early era of adoption of digital instructional technology featured students accessing the available technology for supplemental purposes; technology was not reshaping how teachers provided curricular instruction in classrooms but was rather an ancillary device.

In both the 1990-91 and 1991-92 school years, the district continued to add both Apple and IBM computers to classrooms based on decisions made on formal acquisition requests by departments and subsequent approval by a Technology Committee formed at the district level. These computers were funded via both general operating funds and through capital outlay funds.

TECH6 recounts the proposal and decision-making process: “A presentation was made by various teachers or staff to our four-member technology committee and the requested discussed how they would implement their plan. We would prioritize all the requests and approve what we could. It was basically very simple at that time and not many teachers really knew what they were asking for, they just knew they wanted it.” Again, the impetus behind the adoption of digital instructional technology was not directly tied to solving an instructional need or problem.

As the requests multiplied during the 1991-92 school year, district leadership led by the director of secondary education, formed a five-year technology planning committee with the purpose of developing a plan to address the following five areas: 1) curriculum needs in content areas including media centers, 2) outcomes based education and instructional management, 3) student services, 4) operations and management, and 5) personnel. The goal was for the plan to include a decision-making process to prioritize the purchase of hardware and software appropriate for established purposes in the district, both tied to classroom needs and requests as well as operational needs. The committee’s responsibilities were to assess current needs, to explore what was needed for the near and long range future, to establish an implementation timetable, and to set priorities for district technology goals. The findings were to be presented to the Superintendent and the Board of Education. Subcommittees were formed to investigate what was best for the direction of the district with respect to classroom technology, as well as other technology components district-wide to include infrastructure and administrative technology functions. One of the subcommittees formed was a district technology cadre – the Computer Information Network group – comprised of district teachers and principals from all levels (elementary, junior high and high school). TECH6 remembers the participation of parental involvement: “It was parents of students asked to participate, and those parents were involved with technology in their position, their occupation. We had them come in and evaluate what we were doing and to help with a vision of where we should go with this. Going into that meeting the district's hope was to just get a few more computers in each of the schools. But, our parents and others had a bigger vision in mind." Thus, the district's stakeholders provided external influences decisions surrounding the formation of the district's goals and vision of digital instructional adoption.

To garner additional feedback, approximately one hundred staff members from all levels were involved in an interview process and, the entire district staff was invited to participate in a technology survey. Additionally, all buildings in the district were asked to provide an inventory of all technology equipment available to staff as of May, 1992. The feedback was tallied to provide a baseline of quantities and types of technologies available in classrooms across the district. The IBM Corporation assisted the district with facilitating the structured interviews and sending the surveys to all district employees to identify key issues, employing a method used across the nation by many local educational agencies at this time. This information would be used to provide essential data in the development of a multi-year district technology plan.

In the fall of 1992, the district technology planning committee published its primary findings of the study and their recommendations to the Board of Education. The recommendations were outlined in four phases to be adopted and implemented over multiple years. The study found a need for equitable and available technology at all levels. Equity and standardization of digital instructional technology began to take root and inform much of the district decisions regarding future technology adoptions. The computer inventories by building showed a ratio of fifteen students to one computer with ranges by level and building. These ranges were significant between some of the district's schools. The primary issues of concern as outlined in the findings of the study were: 1) use of technology to develop student competencies 2) updated, compatible equipment to meet student and staff needs 3) an effective process for decision-making about choice, purchase and appropriate use of technology 4) ability to store, retrieve, report and share information 5) adequate communication systems, and 6) consistent staff training plans. The primary recommendations of the study were to: 1) identify and incorporate pre-kindergarten through grade twelve technology outcomes for students in all areas of the district's curriculum, 2) provide networked compatible equipment to allow equal access for every student and staff member, 3) provide a multi-phase plan for the purchase and installation of equipment and applications with a defined process for decision-making, 4) provide ready access to appropriate information for operation of the district and to facilitate student learning and outcomes, 5) provide connectivity to all parts of the district and global community, and 6) provide appropriate training to all staff. The details of the implementation plan with respect to classroom technology components were divided into four phases as shown in Table 4.1. Funding for each phase was anticipated to require more than one year to accommodate the management of each of the phase's implementation as well as fiscal year funding impact. The seven-year timeline dictated a completion date of 1999 (TACR, 1992).

Table 4.1
Technology Planning Committee Recommendation Implementation Phases – 1992 (source: TACR, 1992)

Phase I	• Automate junior high libraries • Provide remaining elementary schools with computer labs • Network one lab at each junior high school and senior high school • Connect all buildings to the district mainframe computer • Begin a staff technology training plan • Provide support personnel for implementation • Develop cabling design for all buildings for networking
Phase II	• Network all elementary libraries • Network additional secondary building labs • Establish multi-media centers at all secondary schools • Begin to network instructional workstations in all K-12 classrooms • Provide additional administrative services • Continue staff technology training with support personnel
Phase III	• Provide additional elementary and secondary library networking • Complete junior and senior high library networking • Provide additional networked labs at elementary and secondary schools • Complete senior high classroom networking • Establish pilot elementary and junior high classroom networking • Provide additional building level administrative services • Provide additional support personnel for staff technology training
Phase IV	• Complete elementary and junior high library networking • Complete elementary and secondary senior high networked labs • Complete multi-media centers • Complete elementary and junior high classroom networking • Complete building level administrative services • Continue staff technology training

At the completion of Phase I, the district anticipated providing over 16,000 students with computer technology in computer labs and media centers in all school buildings. At the completion of Phase IV, the district's goal was to provide students in all grades with daily use of computers in all classes and subject areas. The cost of the entire multi-year technology plan was estimated to be approximately 24.9 million dollars, which was calculated to be at a cost to the district of \$.70 per student per day over ten years (TACR, 1992).

The district technology planning committee identified the multi-faceted benefits of the plan: 1) the enhancement of student learning, 2) providing effective and timely information and communication, 3) efficient use of resources by staff and students, 4) the development of educators as technology leaders, and 5) the promoting of a technologically literate community. Though these were the rationale provided, this was never assessed by the district for its impact in future years. The implementation of the plan would establish one "model" elementary school, one "model" junior high school and one "model" senior high school. Each "model" school was to be identified as having the following characteristics: networked classroom labs of four computers per classroom, instructional work stations for all staff, automated libraries, and automated offices (TACR, 1992).

Interview participant TECH6 stated:

> Right away we knew four computers in every classroom wasn't going to work as there wasn't physical space in the classroom for that many computers. So, it was reduced to two computers per classroom. That was before computer labs in every building. So, the model was five computers in the library and two computers in each classroom. Prior to this timeframe, it was up to each individual building to request technology through application related to some special type of initiative at the building level and those computers were not networked. This was the first time the district provided networked classroom computers and they were IBM computers. But, really it was the same type of activities the students were using them for.

The use of digital instructional technology at this point was primarily teacher centric with access to email in the classroom in addition to the use digital presentations via PowerPoint becoming more readily used for instruction. Thus, the curricular purposes for using technology was limited at the same time the goal of increased diffusion of digital instructional technology in classrooms across the district increased.

In the fall of 1992, concurrent to the development of the multi-year technology plan, a new high school opened in the district as the first completely networked building with a token ring local area network structure. This high school opened as the district's chosen "model" high school with the intention that the other two existing high schools would be brought up to the same level with respect to networked classroom computers and equitable quantities of computers and technology in all curricular areas. This would be completed as part of the progressing development and implementation of the multi-year technology plan.

In addition to the components of the four phases of the multi-year technology plan, it was determined that items such as overhead projectors, graphing calculators, VCRs, etc. would be purchased based on individual and building needs and requests. Additionally, innovative projects involving technology which had goals of motivating and inspiring students' use of technology would be received via application, reviewed by the technology planning committee, and considered for application via pilot proposals. The technology committee would meet twice yearly to review any special one-of-a-kind technology requests as they related to providing innovative technologies via pilot studies in high-interest areas for students. For example, computers and modems were placed in biology departments at all high schools in the district in 1993. This provided a technology component involving shared data bases via computers and modems, which was in alignment with an updated district biology curriculum. It entailed the placement of IBM computers, 5.25" floppy drives, 2400 baud internal modems and printers in all biology classrooms. Thus, fourteen complete computer systems, each costing $2,548, were placed in classrooms and funded by general operating funds and supplemented by capital outlay funds. Other examples of technology devices which were reviewed by request were: video equipment, special education technology peripherals, projection televisions, MIDI compatible audio equipment, LCD overhead computer displays, video toasters and slide projectors (TACR, 1992).

This nine year era from 1984-1993 suggests there were external stakeholders influencing district decisions as well as what may have been in some regards subtle isomorphic influences as the district sought first to explore the technology decisions of local districts to inform its direction and decision-making regarding selection and adoption of digital instructional technology. The district explored many options, made initial decisions, created its first technology action plan, and invested in technology infrastructure and devices during this era.

1994-2003: Model Schools Era. The implementation of Phase I officially began during the 1993-94 school year with capital outlay funding for student computers for writing labs at two of the senior high schools. Additionally, student computers were purchased to begin to construct the components of one "model" junior high school in the district. The "model" senior high school had just completed its first full academic year.

Phase I provided IBM student computers in a networked lab at the remaining two high schools and the placement of twenty-five student computers in labs at the remaining junior high schools. This was part of Phase I of the multi-year technology plan and cost the district $117,810. As previously anticipated by the technology planning committee, the allocated funding to complete all phases of the project was insufficient. Thus, in the fall of 1994, the Board of Education and district patrons voted to pass a 58.8 million dollar bond of which 12.4 million dollars were allocated to fund the technology priorities established in the multi-year technology plan (BOND, 1994). This amount was roughly half the amount initially anticipated to complete the four phases of the multi-year plan. One technology leader remembers this bond and its intended goal:

TECH 3 states:

> The advisory group for the bond was all about the breaking age of technology and what the newest and best resource was for students. If we wanted to kind of spring forward and be out on the bleeding-edge, then we would want to provide that kind of computer power for kids. Beyond that, I don't think there really was a definite goal in mind. Not a problem we were trying to solve. It was just a desire to be a leader in the state in acquiring technology. I think in the back of everyone's mind was the idea that we would develop some curricular goals once we had the hardware. They had an advisor who had experience with what other school districts from the east and west coast were doing. What was evident I think was there were two sides to the camp at that point. There was a good feel for what the district wanted to do in terms of business, student records and those kinds of thing, but there wasn't as much clarity with respect to what we wanted teachers and students to be able to do in the classroom.

Thus, this technology leader's impression of the district's decision to obtain the technology was that it was an effort to be viewed as a leader in the state without establishing concrete curricular goals first or defining a method in which to assess whether the goals were met by the adoption and diffusion of the technology.

In 1994, with the funding from the recently passed bond, the district began to equip district classrooms with what the district named "IIPC Carts" or Interactive Instructional Presentation Centers. These presentation stations were comprised of a desktop computer, keyboard and mouse, speakers, VHS tape player and video converter box connected to a large 27" color television. These components were mounted on a rolling instructional cart. The total cost of an IIPC cart and its components was approximately $1500 at that time. The goal was to provide teachers an effective way to both teach and project computer images using technology, as well as to provide students a computer in the classroom with which to interact and present their work to the entire class. These IIPC carts were stand-alone computers at the time of placement, not connected to the Internet or the building's local area network. The goal was eventually to place an IIPC cart in every classroom in the district. To begin, nine carts were to be placed in each elementary, twenty-two were to be placed in each junior high school and thirty-two were to be placed in each senior high school. These would be shared as needed by teaching staff in each grade level or curricular department until they could be placed in each classroom – with the goal of eventually having each computer networked.

The IIPC carts, influencing teacher delivery of content in a digital format, were a major focus of increasing technology access across the district during the 1994-1996 timeframe, together with automating administrative functions (accounting, lunchroom, media services), and improving the district's infrastructure (fiber networks, network services, cabling design, Internet pilot) to ready the district for the next phases of the multi-year technology plan. TECH6 remembered the IIPC cart providing "a much-needed solution for teachers to demonstrate on the computer and students could view it." She states one limitation remarking, "it never had the pixel capacity though to make it a really clear image."

TECH6 further remembered how the IIPC computer were used by students:

> Students would go up to use the computer, sometimes in groups of two, and work on it. It was about that time we started problem-solving with the principals on how to build a computer lab in every building for equity across the district. The IIPC cart was a success I think, but, it just wasn't going to cut the mustard long-term. So, we began to move special-use classrooms around where we could to begin to identify areas where computer

labs could be established. They weren't always the most teacher- or student-friendly. We just used the available space we could find. We put a larger television screen monitor up in these areas to assist teachers and computer lab instructors with displaying instructional pieces.

At the start of the 1996-97 school year, there were many components of all four phases of the district's multi-year technology plan completed; however, the 12.4 million dollars provided by the 1994 technology bond was close to being depleted with many additional components yet to be finished (TACR, 1996). The district's technology project status with respect to digital instructional technology impacting classrooms at the time is summarized in Table 4.2.

Table 4.2
Technology Planning Committee Completed Components of Implementation Phases – 1996 (source: TACR, 1996)

Phase I	• Junior High libraries automated • Computer Labs installed in all elementary buildings • Networked one lab in all junior high and senior high buildings • Staff technology training plan established • Cabling plan developed for all buildings to connect classroom computers
Phase II	• Additional computer labs networked at the junior and senior high schools • Multimedia centers established at all secondary schools • Increased staffing for technology training
Phase III	• Additional elementary libraries networked • Completed junior and senior high library networking • Provided additional networked computer labs at all three levels • Established pilot classrooms for networking elementary and junior high classrooms • Continued staff technology training plans
Phase IV	• Completed all elementary and junior high library networking
Summary of Expenditures	• Total estimated cost of multi-year technology plan over four phases: $24,900,000 • Total amount approved in 1994 Technology Bond: $12,500,000 • Total actual expense as of Fall, 1996: $11,638,440

A typical elementary building in the district at this time had the following digital instructional technology available: one computer per grade level in grades kindergarten through six (included as part of the IIPC cart), twelve computers per computer lab and four floating computers to be used in the library and by the special services department.

TECH3 describes the impact of the computer lab on schools:

> An evolution of the ramifications of the Computer Lab Associate position being created at the elementary level was to provide elementary staff with release time. The resounding voice at that time from teachers and district leadership was students needed a place to go as a class and receive instruction versus adding additional computers into an already small classroom space. The computers at this time were stand-alone Apple II computers. There were a couple of elementary schools where large discrepancies existed due to space availability. That's just the way it was.

Thus, the establishment of computer labs in the elementary buildings was more of a response to the need for teacher release time than it was to enhance instruction. Students attended computer lab time for only thirty minutes per week, taught by a classified versus certified staff member.

A typical junior high school building had one computer lab with eighteen stand-alone computers, ten computers total in dedicated curricular areas such as science, industrial technology and special services, and three computers available for student use in the library. Finally, a typical senior high school building had two networked computer labs, approximately forty total computers shared in dedicated curricular areas such as business, home economics, science, industrial technology, newspaper, yearbook and special services. TECH6 describes the high school labs at that time as "a nightmarish disk shuffle" referring to the required use of floppy disks to store, retrieve and share data. She states, "Sometimes you had to have a certain disk in a certain machine and stand on your head – and then it would work."

Continuing throughout the 1996-97 school year, digital instructional technology was increased in classrooms across the district as funds were available to include building-wide networking of all model schools (four elementary, two junior high and one high school building). This provided additional networking of the IIPC carts in individual classrooms connecting additional classrooms to the Internet. Additionally, during the same school year, a video distribution system (Ranger System) at the model senior high school was completed providing on-demand video access and distribution to all classrooms, with plans to extend this project to the other two senior high schools.

It was in the spring of the 1996-97 school year, with the realization that technology was rapidly changing and many facets of the multi-year technology plan were left unfunded, district leadership formed a Technology 2000 Task Force, a community and school leader committee, designed to identify projected needs to enhance existing technology and ensure leadership existed for providing students access to currently-available technology to impact student learning. The task force was to revisit the multi-year technology plan for any needed modifications and make recommendations for the funding of the next phases of the plan. Specifically, their tasks included: (1) Evaluate current technology plan and status of implementation, (2) Identify existing expansion needs for enhanced access, (3) Revise existing plan to reflect rapid change in technology, (4) Develop expansion projects for innovative learning models, (5) Enhance communication options for expanded technology, (6) Identify hardware and software needs, (7) Identify projected costs with timetable for implementation (TTFR, 1997).

In April of 1997, the Technology 2000 Task Force completed its study and presented its findings to the Board of Education, identifying needs in three areas: (1) physical aspects of technology needs, (2) funding needs, and (3) recommendations for teaching and learning surrounding digital instructional technology and its use in the district's classrooms. In each of these areas, specific recommendations for the district's future technology focus were made as shown in Table 4.3.

Table 4.3
Technology 2000 Task Force Recommendations – 1997 (source: TTFR, 1997)

Physical Aspects	• Providing Stable Infrastructure/Backbone/WAN performance • Fiber from the Education Center to High Schools • Fiber from High Schools to junior high, elementary and support buildings • Increase line speed to all buildings • Mirroring data/secure backups • 3-year rotation cycle for replacements of aging technology in buildings/classrooms • Increasing RAM and disk space in all classroom equipment
Funding Needs	• Investigate and provide appropriate level of technical support • Investigate all sources of funding (grants, bonds, etc.) • Inequity addressed due to technology implemented in new construction • Capital expenditures should not be paid off over a period of time longer than the useful life of the technology itself (7 years)
Teaching and Learning	• Increasing training as buildings are networked • Create instruments to measure effectiveness of technology in the classroom • Installation of a Flex Computer Lab at two elementary buildings • Cable Television installed in all junior and senior high social studies classrooms • Network one computer in all classrooms (in phases at all levels) • Portable keyboards (one cart) per elementary building • Distance Learning Lab at six junior high schools and all senior high schools

In summary, the goals established by the task force were to continue to set and implement minimum standards for classrooms and school buildings, improve the performance and capacity of the district's network and infrastructure, provide appropriate and timely support and training to teachers as well as classified staff, and to measure and evaluate the effectiveness of technology in the learning environment. The goal of standardization and equity of access to digital instructional technology continued to be a driving factor in this era.

Subsequently, in October of 1997, partially in response to the task force recommendations and the need to address construction of new school buildings, the district's patrons passed a 123.72 million dollar bond with twelve million dollars allocated to funding additional technology priorities outlined in the Technology 2000 Task Force summary to the Board of Education (BOND, 1997). In addition, the technology priorities established in the prior multi-year technology plan were funded. This bond also funded land and construction for seven new district school buildings. In 2000, another 4.5 million dollars was allocated for technology, part of a 60 million dollar bond targeted for two more new school buildings (BOND, 1997). As part of these two bond elections, Phase V, VI and VII were added to the original multi-year technology plan. It was previously anticipated that the completion of Phases I through IV would be completed by 1999. New elements related to digital instructional technology included for implementation in the newly established phases are shown in Table 4.4.

Table 4.4
Technology Planning Committee Recommendations – New Phases – 2000 Revision (source: TTFR, 2000)

Phase V (completed in full with 1997 bond funds)	• Begin installation of multiple PCs in junior and senior high science labs • Increase computer ratio in all debate classrooms • Increase computer ratio in all junior and senior high industrial technology labs • Establish a pilot of senior high SMART classrooms • Establish a pilot of senior high handheld programs • Upgrade Internet speed district-wide • Install international language labs in all senior high schools • Install distance learning labs at two high schools • Upgrade outdated computers district-wide according to replacement cycle plan • Provide for new technology in new construction and building additions
Phase VI (completed in full with 1997 and 2000 bond funds)	• Finish installation of junior and senior high science lab computers • Provide all technology components for new high school #4 • Increase standard (quantity) for all library computers • Install video production equipment in all high schools • Upgrade outdated computers district-wide according to replacement cycle plan • Add wireless laptops for eLearning in all high schools • Pilot network printing district-wide
Phase VII (completed with 2000 bond funds)	• Networking of 2 elementary buildings and 1 junior high building • Upgrade outdated computers district-wide according to replacement cycle plan • Provide computers for 21st Century Programming courses • Provide for new technology in new construction and building additions

One of the recommendations of the Technology 2000 Steering Committee was to purchase non-networked stand-alone laptop computers for three larger elementary buildings needing additional access for students due to lack of space in computer labs at these buildings. This laptop computer was first piloted during elementary summer school in the summer of 1997 and determined to be a device that would address this need. The Laser PC5 device was a portable laptop with limited capabilities such as a built-in word processor, spell checker, database and spreadsheet. It was smaller in size which allowed it to be easily transported within the school building. The devices were primarily used for keyboarding and word processing practice by district elementary students. Each device cost approximately $300 and were housed in a portable cart for charging. The district purchased eighty Laser PC5 laptop computers for three larger elementary school buildings. Only two technology leaders interviewed remembered this device. TECH2 remembered the device unfavorably: "The kids weren't interested in them and we bought a million of them. We should have got student buy-in and we didn't. We've done that a few times." This type of digital instructional technology device was initially focused on the attempt to solve a problem (lack of physical classroom space); but, failed due to insufficient prior investigation and buy-in from staff.

Another distinctive digital instructional technology innovation implemented by the district in 1997 was provided via an Excellence in Education Grant. This grant was funded in the amount of three million dollars over three years and provided flatbed scanners and Newton MessagePads to multiple teachers in all curricular areas and grade levels across the district, via an application process (BOESR, 1997). These devices were designed to assist teachers with "on the fly" assessments to enable an easier method of collecting data on students. The flatbed scanners, a component of the grant, were to be used to begin to collect data for the first student digital portfolios. The Newton MessagePads provided a Learner Profile report when synced to a desktop computer to allow sharing of information and data collected on the device. The device lifespan was short-lived as in 1997, Apple itself nixed the device after selling far fewer devices than expected.

One district technology leader (TECH2) remembers the initiative this way:

> Staff using the device were thoroughly trained, but its usefulness and impact was never fully realized due to limited usefulness and the device's poor screen resolution and poor handwriting recognition. The major benefit for our district from this initiative was that of staff being introduced to the technology and how to correlate it to what they were doing in the classroom. That would be usable information for the future. This was Apple's first

attempt at a personal digital assistant, but had limited usefulness due to very few applications being developed specifically for education. But again, the training on the concepts related to the device were transferrable and the largest benefit from this initiative.

Throughout the nineties, the district's installed classroom computers became antiquated and gradually became unable to effectively execute new software programs. Thus, during the 1998 school year, software upgrades (Windows 97, MS Office 97, E-mail and Web Browsers) required computers in computer labs and district classroom computers to be upgraded to ensure adequate performance. This was the first occurrence of the need to upgrade multiple classroom computers district-wide as a result of third-party software upgrades. In this instance, only the processor was upgraded in these computers to minimize the cost to the district, $256,800 (BOESR, 1998). TECH1 stated: "This was just one of the consequences of having to stay up-to-date with software and that forcing changes and cost related to hardware. This type of thing takes away funds from funding for classroom initiatives which some people don't realize."

One of the goals of the Technology 2000 Task Force was the baseline standard for elementary schools to include one networked computer in every classroom (Kindergarten through Grade 3) and three networked computers for every classroom (Grade 4 through Grade 6) (TTFR, 1997). During the 1998-1999 school year, the network cabling for completing this work for the five remaining elementary school buildings was finished, and as a result, all elementary school classrooms were connected to the Internet and to the district's local and wide area networks. Network cabling at the sixth and seventh junior high school was also completed at this time, ensuring all classroom computers in those buildings were networked as well, and completed the entire cabling of classrooms project for all secondary schools in the district.

In 2002, eleven total digital classroom technology systems were installed at the district's three high schools, funded by the general operating fund and College Now funds (BOESR, 2002). These eleven classrooms would pilot components of what the district deemed to be a "digital classroom" with the intent of upgrading all district classrooms to that level within the next several years.

> TECH5 remembers the impetus for the digital classroom model was teachers wanting: (to) get away from the old overhead projectors. They wanted something that would connect to their computers. They also wanted to not be tied to the front of the classroom. Those digital annotation devices provided that for them. But, to start it was the Mimio devices and they were still tied to the front of the classroom.

District leadership wanted to see teachers moving about in the classroom and this was deemed a way digital instructional technology would aid in this endeavor. The digital classroom technology system included: a digital overhead projector, digital interactive whiteboard recorder/touch screen device, radio frequency wireless keyboard and mouse, closed caption decoder, dry erase projection marker board, DVD & VCR combination player, VGA document camera with light source, and a ceiling mounted dual speaker. The cost of the entire system installed was roughly $5,000 per classroom (BOESR, 2002).

In the spring of 2003, the Board of Education approved the purchase and installation of SMART (Scholastic Media and Real-World Technology) systems in all classrooms at the newly-constructed high school opening in the fall of 2003 (BOESR, 2003). These classrooms received the digital instructional technology components listed above. The cost of this implementation was roughly $400,000 and was funded by the 2000 bond. This was the first school in the district to have every classroom in the building outfitted with this type of digital instructional technology and thus deemed a digital classroom school. It set the foundational standard for the remaining schools throughout the district. TECH3, who was heavily involved in the initial implementation stages of the project, stated:

> The digital classroom technology was intended to benefit teachers while at the same time providing a more engaging classroom environment for students. However, technology directly impacting kids remained the technology in the computer labs really. The digital classrooms at first took time for teachers to embrace and learn. It was more about ease of use for them as anything else.

This era was marked by extensive expansion in the district, causing disparities between brand new school buildings equipped with the newest and latest technology available and older established schools with lacking technology. Coupled with the rapid advancement in the technology field itself, the district struggled with establishing model school characteristics that could feasibly be scaled-up to reach all students at all levels. Technology use in the classroom also expanded from primary use by teachers for instructional purposes to also include student devices (such as Laser PC5 laptops and the first piloting of Palm hand-held computers). However, the main focus of this era remained that of establishing equity and standardization across all school buildings in the district. Curricular goals did not seem to be clearly defined and the impact of adoption of digital instructional technology was never assessed.

2004 – 2013: Digital Classroom Era. During the 2003-2004 school year, the district deployed Palm model 515 hand-held computers in an effort to provide a cost-effective digital technology tool to enhance student achievement and provide student access to instructional resources for learning (BOESR, 2003). This decision was made by the district's technology director with advisement from the Superintendent of Schools. The district provided each student at the newly-constructed high school a hand-held computer equipped with a keyboard and word processing, spreadsheet, presentation and database software. The device had an expansion card providing the capacity to store dictionaries, a thesaurus, and other supplemental books and software applications to support specific curricular areas. It also featured a universal connector allowing interactivity with science probes and connection to an external keyboard. Beaming functionality allowed teachers and students to share class notes, data and assessments. It was the goal of the district to include the use of hand-held computers as a part of the overall technology plan for each of the district's four high schools as a mix of student hand-held computers, desktop computers and laptop computers. It was felt this initiative would serve as a way to get digital instructional technology in the hands of every high school student at a lower cost than a laptop computer. The initial total purchase cost of the Palm Model 515 was roughly $400,000 (BOESR, 2003). This provided all students at the new high school a personal device to take home with them daily. Additionally, students in the 21st Century programs at the oldest high school were provided a personal device, which was later upgraded to a Palm Zire 72 model and expanded to a 1:1 ratio in 2004. Three elementary schools and one junior high school were provided class sets (two per elementary and four per junior high) of the hand-held Palm Zire 72 in 2004. The cost of this phase of implementation was roughly $830,000 (BOESR, 2004).

In the fall of 2006, the last district purchase of Palm hand-held computers was made at a cost of $695,000 (BOESR, 2006). This provided a new wireless model (Palm TX) to all students at the first high school, replacing the model currently used by students. An additional 1,250 devices were purchased for singleton classrooms and interested teachers at the remaining two of the district's other high schools. At this point, the oldest high school, with a 1:1 ratio of Palm hand-held devices, was not interested in upgrading to the newest hand-held computers. The current models at each school were repurposed across the district establishing a foundation number of hand-held computers at all junior high schools in lab sets. Additionally, lab sets were provided to interested teachers at several elementary schools in the district. The funding for all Palm hand-held computers was allocated with a combination of the general operating and capital outlay funds. Overall, the Palm hand-held computer initiative cost the district approximately two million dollars over the course of five years.

In the fall of the 2003-2004 school year, the district sought to provide a means for displaying 2-D and 3-D objects/documents as part of the digital classroom solution. Thus, digital document cameras were purchased for multiple buildings in the district, with the intent of increasing the numbers as funds became available for digital classrooms. This decision was a result of district technology leaders gaining exposure to these types of devices from multiple vendors and wishing to deploy them in the district's classrooms. The original document cameras were placed in selected classrooms at two high schools and various other buildings for piloting. The cost of a high-resolution unit at that time was $620 and a lower resolution unit was $400. At the start of the 2005-2006 school year, the district purchased seventy-five additional units for the first defined phase of the digital document camera initiative in selected buildings to be shared one per grade level and/or department at a cost of $75,000 (BOESR, 2005). These expenditures were funded with 2003 bond funds and capital outlay funds (BOND, 2003). Schools were allowed to use building funds to purchase additional cameras as funds were available.

Also in the fall of 2003, the district began to replace computer monitors with flat panel displays. These displays would provide a longer life expectancy, energy efficiency as well as a smaller footprint in the classrooms across the district. The cost per device at that time was $138 more than the traditional computer monitor, but was determined to be offset by the life of the display and energy efficiencies to be gained. At this time, the district was on a five year replacement cycle and thus one-fifth of all computers and monitors were replaced each year. The replacement cycles were funded primarily from capital outlay allocations each year.

In October of 2003, the district's patrons passed a 73.5 million dollar bond which included six million dollars for technology (BOND, 2003). The funds from this bond allocated for technology would be used primarily to equip the remaining classrooms in the district with digital classroom technology, which would not be possible without supplemental funding. Providing equity of access and standardization of digital instructional technology continued to be a vigorous goal of the district. Additionally, this bond election would provide funding for technology for projects and initiatives which were outside the scope of the normal replacement cycle for existing desktop computers. For example, the district purchased graphics and animation computers, television and audio recording studio equipment, and more robust laptops for several of the specialty programs at three of the district's high schools. These computers, laptops and audio/video equipment were high-end devices as compared to the typical desktop and laptops and other technologies distributed in the typical district classroom. They were purchased to prepare students for real-world experience using industry-standard equipment and software for that time period.

The 2004-2005 school year was the beginning of the effort to standardize all remaining district classrooms with digital classroom technology (i.e. ceiling mounted projector, amplified sound, computer workstation with CDRW, wireless keyboard and mouse, VCR/DVD player, white board, and interactive annotation device). Bond funds were used for this purpose. The digital annotation device at this time was the InterWrite School Pad. The cost was approximately $485 per device (BOESR, 2004). The district purchased approximately two hundred of these devices initially with the goal of providing a means for teachers to move about the classroom while controlling their computer and using a stylus to interact with documents viewed by students. This decision was made after multiple models were investigated by district technology leaders. Two hundred classrooms were outfitted to include all newly-constructed buildings (two elementary and one middle school), library media centers in all existing elementary and junior high buildings and additional classrooms at the three oldest high schools. The newest high school opened with this technology in all classrooms.

The 2004-2005 school year was the first school year the district began to strategically place laptop computers in various locations in the district. The district had begun to pilot two distinct wireless connectivity solutions at one elementary and one junior high school building to preface this implementation during the 2003-2004 school year - preparing the way for wireless connectivity at other buildings. Approximately 1,300 laptops were approved for deployment in the 2005 school year (BOESR, 2005). These were placed at all new buildings in August 2005 and were designed to be used for Kansas state assessment testing in all buildings across the district. Mobile laptop carts with wireless access points were also purchased to be used until full-building wireless connectivity became available in all schools. The total cost of the first large deployment of laptops was roughly 1.3 million dollars and funded with 2000 bond monies (BOND, 2000).

During the 2004-2005 school year, teachers across the district began to pilot classroom personal response systems (CPS) to assist with evaluating and quantifying student data as well as to attempt to more actively engage students in their learning environment. Technology deemed the units to be successful after preliminary feedback from teachers using them. Forty classroom sets were ordered to increase usage across the district in singleton classrooms and departments at a cost of approximately $74,000 (BOESR, 2004).

The 2005-2006 school year saw the completion of all digital classroom installations at all four high schools in the district – with additional classrooms outfitted at all junior high schools not completed. One hundred fifty-six classrooms received this equipment in the spring and summer of 2006 at a cost of approximately $457,000 (BOESR, 2005). Document cameras were supplied on a shared department/grade level basis as before. The installation of digital classroom equipment continued to be the focus of the technology division and district leadership. This phase of the digital classroom installations included a substitution of the interactive annotation device – moving from the InterWrite School Pad to the SMART Airliner Slate tablet. This tablet provided SMART Notebook software to all teachers at no additional cost, which was the preferred digital instructional software application desired by teachers in the district. The cost of these devices were approximately $640 each. The district deployed SMART Airliner Slate tablets in all new digital classrooms and eventually retrofitted all existing digital classrooms where core curricular courses were held with this device. Subsequent to this deployment, during the 2007-2008 school year, twenty additional classrooms at seven junior high schools were equipped with digital classroom technology. Additionally, two classrooms at twenty-seven elementary buildings received digital classroom equipment. This deployment completed all junior high school classrooms. These two hundred classroom installations were funded with capital outlay funds at a cost of approximately $515,000 (BOESR, 2007). With these 220 installations, the total number of digital classrooms in the district was 355. The cost to fund the remaining 1,278 classrooms would total over five million dollars and would require funding from another source.

During the spring of 2006, the Board of Education approved the purchase of wireless system infrastructure hardware with 2003 Bond funds (BOESR, 2006). Demand for expanded student access to technology for both assessments and instruction was the provided rationale. Wireless technology was becoming the foundation standard for school districts locally and nationally. Limited space in school buildings prevented the installation of additional hard-wired computer labs. Thus, the need for a wireless solution that facilitated learning and assessment capacity in the district's classrooms was a critical need. The district had piloted wireless access in limited areas in a few school buildings prior to this with limited success. Since that time, major improvements had been made to wireless technology and the timing was deemed appropriate to move this initiative forward. One elementary building was selected to equip 100% of the classrooms with this technology to test the chosen solution. Subsequently, in the summer of 2006, the district began phase two of this initiative and began to provide total building wireless connectivity to all classrooms at all four high schools, two additional elementary schools, an alternative education building, an instructional support building and an early childhood center. Combined, the cost of this initiative for phase two was approximately $225,000 (BOESR, 2006). The wireless infrastructure initially installed in 2006 provided many students secure high-quality wireless access. This also increased capacity for additional laptop initiatives to come in subsequent years.

During the 2006-2007 school year an additional 250 laptop computers were placed throughout the district as the demand for mobile computing and student access to technology increased. Gateway model laptops were purchased at approximately $1,115. The following school year, an additional three hundred laptops were purchased for multiple school buildings across the district. The goal of the district was to eventually place one classroom set of thirty laptops at each elementary building, one classroom set in each core curricular area at each junior high school and two classroom sets in each core curricular area at each high school. The purpose was for increasing access to technology as well as to provide sufficient access to mobile computing for Kansas state assessments. This initiative was the first time digital instructional technology was adopted to accomplish compliance with state assessment mandates; technology decisions were made in reaction to external factors rather than internal stakeholder or leadership planning.

During the 2006-2007 school year, the district formed a task force to study capital needs throughout the district to include a subcommittee designed to research technology needs as well as building and infrastructure needs related to the district's continued enrollment growth. This committee established goals of increasing technology at all three curricular levels in the district, proposing the following increase in technology access to be considered in an upcoming bond election shown in Table 4.5.

Table 4.5
2007 Bond Task Force Recommendations (source: BTFR, 2007)

Elementary	• 100% digital classroom completion • Estimated completion, 2008-2009 school year • Enterprise wireless coverage throughout the building • Foundation level of laptops at all grade levels • One laptop per classroom (K – 2);Three per classroom (Grades 3 – 6) • Additional computer access in SPED, ELL, LMC • Clickers (Student Response Systems) – 10 sets per building • Additional technology strategically aligned to learning
Junior High	• Complete small classrooms with digital classroom technology • Enterprise wireless coverage throughout the building • Laptop carts (30 laptops in each of 4 core curricular areas) • Additional computer access in SPED, ELL, LMC • Additional technology strategically aligned to learning
High School	• Enterprise wireless coverage throughout the building • Estimated completion, May 2007 • Laptop carts (30 laptops in each of 4 core curricular areas) • Math and Science will be increased to 2 carts • Additional computer access in SPED, ELL, LMC • Additional technology strategically aligned to learning

In the fall of 2007, the district's patrons approved a 138 million dollar bond with 11.9 million allocated for technology to fund the aforementioned technology (BOND, 2007). In 2008, another bond election was held to fund additions at the district's four high schools to coincide with the movement of the 6th grade class to the middle schools (formerly named junior high schools) and the movement of the 9th grade class to the high school level (BOND, 2008). This bond included 1.8 million dollars for technology which funded the additional digital classrooms in the expanded classroom of the high schools as well as foundation technology to provide for the 9th grade needs at the high schools.

In the fall of 2008, as part of the Bond 2007 Task Force recommendation for increasing access to student technology to impact student learning, the district purchased 560 sets of classroom response systems (CPS) to create a standard number of sets at each building in the district. Each high school received twenty sets, each junior high school received fifteen sets and each elementary school received ten sets. Using a wide range of hardware and software was touted as a priority by the 2007 Bond Task Force and these devices were being used by several teachers in the district at this time. This decision again was based on district leadership's desire to provide access to all buildings for equity. In total, the district spent approximately $1.5 million dollars on CPS systems over a period of five years (BOESR, 2008).

It was during the 2007-2008 school year that the United States recession began to impact technology funding and expenditures in the district. The property values in the district declined, the district was paying heavily in bond and interest payments, and the mil levy for capital outlay was not fully levied to fund the traditional replacement cycle for desktop and laptop computers, due to the state of the economy. Thus, the district's computer replacement cycle was delayed for several years in many areas across the district. Additionally, all new technology initiatives for classrooms were not able to be funded. The district was able to fund only those items deemed critically important for infrastructure stability as well as those where delaying replacement was not possible. For example, in the fall of 2009 the district was able to replace only 900 desktop and laptop computers due for replacement instead of the needed 1,600 desktop and laptop computers. The same scenario was true in the spring of 2010 when the district deferred the replacement of 1,500 laptops due for replacement as a result of lack of funding through capital outlay, and instead replaced only those desktops and laptops which were no longer functioning properly. Students were using aging equipment and the lack of funding for anything new in the way of innovative projects involving technology was noticeable as technology at that time was not able to provide nor support any new initiatives.

In the spring of 2008, the district began the final installation of wireless hardware infrastructure to provide every high school and elementary school in the district access to wireless access points. Additional laptops were provided to elementary buildings at this time to allow for anytime, anywhere access to complete Kansas state assessments (TLIP, 2005-2010). Laptops facilitated the need for additional access without required facility space for desktop computers and hard-wired labs.

In the fall of 2008, the physical education department was provided digital instructional technology to assist physical education and health instructors at all three levels in the district to safely and objectively measure, monitor and modify students' health and wellness. Polar heart rate monitors, pocket personal computers and accompanying classroom management system software was purchased for approximately $165,000 (BOESR, 2008). This initiative was funded with capital outlay funds and supported the district-approved physical education and health curriculum. It was one of the few new initiatives encompassing technology during the financially-strained years of this era.

During the three consecutive school years spanning fall 2008 to spring 2011, no additional new technology initiatives were implemented in the district due to funding restrictions and budget rescissions. Also important to note was the slowing of district growth and new buildings begin constructed resulting in the absence of bond elections to which to tie technology funding. The district fell behind in the normal replacement cycle, but each year was able to fund a much smaller portion of the regularly-scheduled replacement of laptop and desktop computers. This resulted in increased technical services work orders and computer downtime for students and teachers. In the spring of 2011, the district increased memory in 1,200 student desktops to extend the life of the computer and provide better performance as a result of reduced funding for new computer expenditures. The district was also able to purchase 1,250 desktop computers and 2,200 laptop computers to replace the oldest devices in the district at that time.

In the fall of 2011, the district used 2007 bond funds to complete the final digital classroom installations for all district non-standard teaching spaces or half-size rooms. These were primarily special education classrooms where a normal size digital projector was not needed. These classrooms received a forty-inch flat screen LCD monitor as well as all other digital classroom technology. This cost the district approximately $50,000 (BOESR, 2011). The district had waited for this final phase of the implementation until the transition for 6th grade and 9th grade students had occurred and buildings had decided upon final placement of these classes within their buildings.

In the spring of 2011, as requests from teaching staff and administrators began to increase for increased technology in classrooms, the district began to investigate how the Apple iPad could advance student learning as well as assist administrators district-wide with informal in-class teacher appraisals through a pilot program. Every principal and assistant principal in the district received an iPad for this purpose, as well as every instructional support teacher and coordinator. With limited funding, this process involved an application for consideration to receive a limited number of iPads for classroom use. Applications submitted included those for English Language Learner (ELL) programs, Title I Reading, Title I Math, as well as other curricular areas. This pilot program placed 370 iPads in classrooms across the district at a cost of approximately $200,000 (BOESR, 2011). The district capital outlay budget was used in a limited way to fund this purchase and was primarily funded with individual building funds; thus, not every building was able to participate. This pilot continued throughout the 2012-2013 school year.

At the end of the 2012 school year, the district's technology steering committee felt it would be premature to make a global decision to implement iPads district-wide. As TECH1 stated, "We were gun shy. We just wanted to be sure this time to take time and get it right." They did, however, recognize the value of the iPad in the classroom and made a decision to continue hands-on research with this device. Thus, the district purchased an additional 290 iPads for the 2012-2013 school year to continue the pilot. The second phase of this pilot cost the district approximately $133,000 and was again funded largely from building budgets and district capital outlay funds (BOESR, 2012).

Additionally, during the 2012-2013 school year, under the direction of the director of instructional technology, the district sought to investigate increasing student technology access at all three levels (elementary, middle and high) and in all curricular areas. The study involved district committee members comprised of instructional coordinators, instructional resource teachers, administrators and classroom teaching staff and was named the TAPs (Technology Action Plan) study. The goal was to identify current needs and identify available research related to devices such as the iPad, tablets, laptops and other peripheral digital instructional technology. This involved investigation of multiple devices and implementation models during what the district named a proof of concept period. Teachers in multiple buildings across the district were asked to participate in the investigation of three different devices: iPad, Microsoft Surface Pro tablet and a light-weight longer-battery-life laptop. Teachers in the same building and at the same grade level or curricular area compared the features of the device, what the device allowed students to do and impact on student engagement and learning as measured by individual teacher perception and assignments/assessments. Allowing teachers to compare notes while teaching the same content using different devices allowed teachers to make a more informed decision regarding a recommendation for increasing technology at each level and at what ratio.

The district's TAP committee formed to research and make recommendations reported back to the Board of Education its findings in the spring of 2013, recommending an iPad initiative at all elementary and early childhood buildings at a 2:1 student to iPad ratio. The middle and high school subcommittees requested additional time to study in order to achieve consensus at each of these levels as to the best type of digital technology to provide students. As part of a bond election to secure funding authority to build a fifth high school in the district, a twenty-five million dollar technology component was added to the bond, for a total 244.8 million dollar bond election in summer 2013 (BOND, 2013). The twenty-five million dollars was to be allocated to fund both the recommended 2:1 iPad initiative at the elementary and early childhood level, as well as future funding for a decision at the middle and high school levels. It also would fund catching up the district's aging desktop and laptop computers to a current replacement cycle status.

The decision to deploy iPads at both the elementary and middle level was made after approximately a yearlong investigation by the TAPs teams at designated school buildings. The recommendation of elementary level teachers participating in the Technology Action Plan model (TAPs) was a 2:1 iPad deployment at all elementary schools in the district. The goal of the initiative, via use of the iPad, was to foster deeper learning that allowed students to learn, apply what they learned and demonstrate mastery of the core content in new and more engaging ways. Further, the goal was for teachers at the elementary level to be challenged to teach in brand new ways as expectations of students as researchers and creative learners and producers would be increased. Moreover, the overarching goal for students was to reach new levels of engagement and learning – with the goal of students becoming more independent learners and innovators prepared for their future. A 2:1 iPad deployment (2 students to 1 iPad) was deemed to be the appropriate ratio at the elementary level to continue to foster collaboration and communication between students and not to isolate students individually with iPads.

The recommendation of middle level teachers participating in the Technology Action Plan model (TAPs) was a 1:1 iPad deployment at all middle schools in the district. This decision came a year after the elementary level decision, as additional time was requested by the committee to ensure buy-in from all stakeholders across all curricular areas at the middle level. The features and functionality of the device itself played a large role in the teachers' decision. They felt it provided most of the features of a laptop needed for document creation, while providing additional features which allowed for student creativity, collaboration and innovation to be increased (still/video camera, editing applications, ease of mobility, mobile

APPs for education). These criteria were identified as essential for the desired impact of technology integration across all curricular areas. Access to technology at the middle level had to this point in the district primarily meant access to computer labs and laptops when available at the building level, and not being used by another classroom of students. That access ended or was decreased for many students when they left the school building; and, ironically for some it meant access increased as they went home to 24/7 access to technology. As such, this initiative was meant to even the playing field for many of the district's students as it provided for access to a device that was intended to allow them to discover answers to their own academic questions and allow for continued learning, research and collaboration after leaving the school campus (KSDETP, 2013-2014). The 2013 bond election successfully passed, and during the 2013-14 school year, the district began to distribute approximately 9,300 iPads to elementary students and elementary certified staff to increase student access to technology at this level. Approximately 6.4 million dollars was used to fund this initiative (BOESR, 2013). However, it was deemed to be most cost-effective to lease the iPads and pay the annual lease payment with capital outlay funds. This would reserve funding for addressing increased access at the middle and high school levels in future years, realizing the need for additional funding for increasing student access to technology. This was the first time the district comprehensively placed digital instructional technology devices to be used solely for daily student access in all classrooms in the district at the elementary level – while also providing the same access to the device for teachers in the district.

In the fall of the 2014 school year, the four high schools in the district were asked to pilot a BYOD (Bring Your Own Device) initiative, providing Wi-Fi access for all high school students bringing a personal digital device to school (iPad, tablet, laptop, phone, etc.). The district wished to explore how this type of initiative at the high school level would impact student learning through individual device choice and device availability. The district also sought to understand whether a BYOD initiative at the high school level would impact student access to technology in a manner which would eventually negate the need for district-provided technology devices for all students. At the time of this writing, this implementation was still in a pilot status at all four high schools with a determination to be made within a year as to its impact and viability as a permanent solution for students and possible impact on teaching and learning

The digital classroom era featured the standardization of all district classrooms with the capability for digital content delivery. Additionally, district-wide wireless connectivity provided the infrastructure necessary to support the thousands of laptop devices acquired in large part for the administration of Kansas state assessments. Economic constraints were another factor influencing district decision-making, which prohibited, in many cases, the adoption of innovative technologies and necessitated strategic planning for including technology components in regular bond elections. In evaluating the three eras of digital instructional technology adoption in this district over the past thirty years, use of technology has not yet fundamentally altered the instructional core of schools. The third and most recent era (Digital Classroom Era) provides the greatest potential for reform to alter teaching and learning in schools as increased student access via 1:X initiatives put devices in the hands of students. These student-centric devices have the potential for changing both instructional and assessment models which may result in an enhanced impact on student learning.

Summary of research question #1: evolution of digital instructional technology. The evolution of digital instructional technology in the chosen district within the three researcher-defined eras established in this study is summarized by era in this section. An analysis of the district focus is provided for each era.

1984-1993: The Beginning Years Era. The evolution of digital instructional technology in this district initially began with the district's inquiry into what role and what impact digital instructional technology itself should have in the district's classrooms. The concept of mimetic isomorphism and external influences was at least a small factor even in the early years of the adoption of digital instructional technology in the district evidenced by the district consulting multiple surrounding school districts, as well as seeking input from external sources such as IBM Corporation and community members and parents. These sources provided valuable information to assist with composing the district's first technology action plan and informing the district's first bond with technology dollars allocated. This era was a discovery era where the district attempted to make sense of how technology should impact not only the classroom but the district and its systems and infrastructure. This district, in contacting multiple other school districts for advice, began to try to conform to and resemble other districts experiencing the same pressures – that of trying to appear legitimate as technology expansion in other areas was realized in the education field.

1994-2003: Model Schools Era. This era featured nine new school buildings constructed and fitted with the newest available technologies. The evolution of digital instructional technology began to quickly evolve into an effort to provide equal access and equity across all district school buildings. Existing school buildings were lagging behind in technology hardware and software, and the district struggled to keep up with the demand for equal access for all students in all buildings. The model school structure provided baselines for standards regarding what digital instructional technology should look like at each respective building level. However, TECH3 summarizes: “We didn’t feel we had clear instructional or learning goals however. We just knew they were going to be able to use it (technology) and we wanted it to be equitable.”

During this era the focus transitioned from an initial focus on teacher technology use into a more student-centric application of instructional technology. This was exemplified in the district’s decision to place distance learning labs, international language labs as well as digital instructional technology devices such as the portable typing keyboard (Laser PC5 laptops) in schools. District leadership began to understand the importance of teacher training and professional development during this era as they sought to increase teacher training and established the first major professional development plans involving technology integration in the classroom. It was during this era that official replacement cycles began to impact the feasibility of other technology innovations. Technology research and development was moving at a rapid pace and likewise equipment was aging at the same time software was improving – making the establishment of major expenditures necessary for replacing equipment. The district found itself in a quandary as this tied up funds for these replacement cycles which has continued to be a sustainability concern to this day for the district.

2004 – 2014: Digital Classroom Era. Digital classroom installations in every classroom in the district remained a major focus of the district and additional components were added to the definition of “digital classroom” – document cameras and SMART Airliner Slate digital annotation devices. The district was adamant about equity and ensuring every teacher had the same equipment and access to digital instructional technology tools. This era saw the inclusion of specialty technology projects to meet 21st Century programming demands such as high-end graphics and animation software and hardware, million dollar television and audio recording studios and robust laptops to meet the needs of multiple programs across the district.

Additionally, it was during this era that the external influence of Kansas state assessments began to have a major impact on digital instructional technology adoptions as online computerized assessments became the required method of administration. This had a major impact on the district's funding the adoption of thousands of laptops across the district – adding to the replacement cycle and sustainability concerns of the district. Meeting individual students' needs and providing increased access to digital instructional technologies was a primary goal of the district and its patrons as indicated by multiple school bonds passing during this timeframe. This era also saw the failure of many of the same tools introduced within the era – the same Palm hand-held computers and CPS systems became obsolete and were phased out of district classrooms. Ironically, this era saw not only one of the most difficult financially-strapped timeframes causing normal technology replacement cycles to be put on hold - but also the passing of one of the largest school bonds in the district's history. The focus turned district-wide to student access and use of technology in the classroom and the initial piloting of mobile student devices such as the iPad and longer battery life laptops. The focus had turned from teacher access to student access and personalized learning via digital instructional technologies. The district leadership seemed to have a keen interest in not making wrong decisions, learning from past decision-making errors, and established technology action plan committees to research what teachers felt they needed in the hands of their students to impact student achievement and learning. TECH1 states "This change to a bottom-up decision-making strategy was really important. We knew we had to get teacher buy-in or it would fail."   Thus, the decision to increase technology access for students simultaneously occurred with the decision to get buy-in from the ground up (teachers) for what that would ultimately look like.

Research Question #2: What factors have influenced the district's adoption or non-adoption of digital instructional technology?

An analysis of the archived historical data and physical documents from the district's storage depository combined with themes derived from descriptive interview data from district technology and business staff were used to address research question #2:

1) *What have been the driving factors related to district adoption of digital instructional technology innovations?*

In this section I provide evidence of identified themes discovered from my analysis of the archived historical data and interview responses. I also provide a final analysis of specific digital instructional technologies that have failed, those that have been replaced, and those that have persisted during the past thirty years in this district and the factors influencing their adoption to address research question #2. Four themes emerged from the historical data and analysis of interview responses: (1) External Pressure and Influence, (2) Stakeholder Priorities, (3) Financial Feasibility, and (4) Educational Factors.

External Pressure and Influence. Organizations at times may seek to become like other organizations in a quest for legitimacy. Data from this study suggests that one potential explanation for adoption of technology initiatives in this district, particularly in the Beginning Years Era (1984-1993), was to portray the district as an innovative leader of educational technology adoption. From the very first technology steering committee and subsequent report in 1982, the district employed the practice of researching what surrounding districts were utilizing in the way of technology. TECH3 described the process of evaluating other schools' technology decisions to inform the district's own decision: "We looked at what other schools were doing. We looked a lot at Texas schools because at the time they were a little bit more Midwestern and like us rather than schools in Los Angeles or New York or Florida or Michigan because all of those areas had a lot going on." This points to the desire to be like other organizations facing similar constraints and opportunities within a field. Pressure to adopt innovation was expressed by MIDDLE1:

> Sometimes novelty develops pressure. Sometimes we feel that we're under pressure when actually just everyone wants to have the new device…We need to be careful as a district…Sometimes I think that we have to be careful that we just don't purchase the new device because it's novel or that everyone's buying one.

TECH3 describes the process of continually being aware of the newest technology trends in an effort to be on the cutting edge of innovation: "We were constantly searching trade magazines and websites, conferences, discussion groups, just all kinds of things looking for what was the next big thing." BUS1 described the, at times, conservative nature of the district in making technology decisions:

> We're almost proud of moving slow. So, I'm a little glad (neighboring suburban school district) did what they did because I think it lit a fire that we need to do something…the pressure for more technology kept coming up…They (community) may not know why they wanted more, just that we need more, we know that's the future.

Some technology investments are more successful than others. BUS2 reflected on one particularly costly device investment (Palm hand-held computers) that failed to deliver the anticipated impact on instruction and student learning touted by district leadership who drove the initiative. The vision of the initiative was to reach a 1:1 ratio in all district high schools and solidify the district's technologically progressive reputation. He states:

> I think I have very strong opinions on it, but it's not backed by any data or anything else. I think it was a waste of time and money. I think it was before its time. I think there were some individuals that really thought that we would get a lot of national press from that. That we were going to be on the bleeding edge of that and it was going to pay off.

External pressures in the form of mimicry of surrounding districts and the desire to be recognized as a cutting-edge technology district contributed in-part to the decision to adopt digital instructional technology in this district.

Stakeholder Priorities. The theme termed "stakeholder priorities" emerged to encompass the influence of various district stakeholders (i.e. parents, community members, students) and recommendations from district-appointed technology committee members to the adoption of digital instructional technology. The inclusion of technology in several bond elections was an attractive incentive to voters, BUS2 describes: "Back in those days technology was such a big deal, I don't think many of them (the bond issues) would have passed if technology had not been part of the construction costs of the bonds." Further, families were drawn to this school district precisely because of their innovative reputation. BUS2 continues, "They wouldn't have moved to our county if they didn't believe our school system was leading that charge. Every other county in the state of Kansas tries to be like us. We knew that and wanted to keep that reputation."

Community and parent expectation influenced the specific adoption of the Palm hand-held devices beginning in 2004; TECH3 states, "It wasn't really a promise but there was this understanding that students who attended the new high school would have some kind of personal device." When asked about the community's impact on technology decisions, TECH2 stated:

> I have had direct conversations with the community to say why doesn't our school have more computers? And no one ever when I've been doing this job has ever said to me, 'We have too much technology, we spend too much on technology.' I mean, they all have technology at work and they expect their children to have technology here. It's always been, 'We want more, more, more."

TECH1 described how instructional technology adoption and use has been influenced by students as stakeholders: "Definitely (instructional technology) has been driven by some changing needs in our (student) population. Low-income students, students who are non-English speaking, and low income students have been the focus of some of our programs, like the Read 180 program. So that's an example of our changing population kind of driving some technology."

District technology leaders in their capacity on technology steering committees drove many of the initial adoptions of digital instructional technology. When asked, "Do you remember who the key stakeholders or decision makers were in the early years as far as what types of technology we needed in classrooms?," TECH2 added, "It was the three of us (TECH2, TECH3, TECH6). We really were making most all the decisions. District leaders felt we were more knowledgeable regarding the hardware and what we needed, what would work best." As technology plans were developed and consensus surrounding the details of the plans were obtained, this set in motion many technology initiatives throughout the past thirty years.

Financial Feasibility. A third theme, Financial Feasibility, describes the economic impact on adoption and sustainability of digital instructional technology initiatives. In times of growing student enrollment, a common practice of encompassing technology funding into an existing bond election is credited with provided funds for many technology advancements in this district. BUS2 explains: "Because we were a growing district, pretty substantial growing district, you were able to tack that on pretty easily (to a bond issue) and count on it (funding) being there." As new buildings were built in this growing district and new standards established, existing buildings were retrofitted with updated technology to meet the new standards with funds generated from bonds.

Annual replacement cycles updated one-fifth of all district desktop and laptop computers at a cost of approximately five million dollars per year. One way the district opted to fund technology purchases and replacement of aging technologies was through capital outlay funds until which point the mil levy was decreased to keep property taxes at a steady level for patrons. This was out of necessity when the district's many bond interest and principal payments came due. BUS1 elaborates:

> When the rescissions hit, it was also during a recessionary time. There was a huge sensitivity to the tax levy. There wasn't any room to take it back to eight mils. So we were kind of in a catch-22. There was nowhere to really go for it (funding for technology)…You're forced to get to your next bond issue to have a big technology component. Then that makes absolutely no financial sense.

Additionally, as the district has increased the sheer number of devices (laptops, desktops, and most recently tablets), the replacement costs have increased, which limited the available funds to adopt new initiatives. In summary, financial feasibility is the backbone on which all technology adoptions and new initiatives are both founded and sustained. This district has funded technology via bond issues, capital outlay funds, and a combination of both. The circumstances of the district, state, and nation's economy impacted and determined if technology was advanced or stalled.

Educational Factors. Interview participants described several educational factors that acted as driving factors related to the adoption of technologies. On the impact of computer-based state assessments, TECH3 said:

> The whole idea of state standards or national standards or whatever for education, that state testing kind of drove us to where we are now with so much technology. I mean, the state said that we're going to go on-line (for test administration), and we said, 'well, okay, we've got to figure this out really fast.' So that was the initial distribution of laptops. Had that not been a high priority in Kansas, we might not have them. I think the benefit of having them (laptops) far outweighs anything that came from that test.

Classroom technology devices were adopted to allow for flexibility of teachers during instruction. TECH2 said, "District curriculum leaders were not happy with the idea of the teachers just being at the front of the classroom at the board. They wanted them circulating because that's a big classroom management issue that they wanted the teachers walking around in the room and not up at the board or at their desk."

Technology adoption has not been uniform across all grade levels in the district due to the sophistication of the curriculum and the presence of advanced technology-centric programs at the high school level. The curricular demands in specialty programs at the high school level have necessitated funneling disproportionate amount of funds for technology and cutting-edge devices. TECH1 elaborates:

> Our high schools are being driven by some of these very high-tech programs that are costing the district a lot of money. I personally struggle with that. I see the value. But funding those programs and sustaining those programs is kind of robbing Peter to pay

Paul. I wish there was a different kind of mechanism to help support and fund quality programs at the middle and elementary levels.

Curriculum has also led to technology's use in classrooms. Referring to curriculum driving technology decisions, TECH1 states, "I think our international language labs, our EnVision math that we are now running at the elementary levels, and we just adopted this Journey reading program for elementary. I think those initiatives drive the need for hardware or technology." TECH6 articulates that technology decisions are "always curriculum based. Every decision from day one of putting them (technology devices) in the classroom was curriculum based." In summary, the automation of Kansas state assessments, desire to enhance teacher instruction, technology needs of specific curricular programs, and selected curricula have all contributed to the adoption of appropriate technologies in this district. These were all used as rationalization of multiple adoptions of digital instructional technology; however, their impact on teaching and/or learning was never assessed.

Summary of research question #2: driving factors related to adoption of technologies. The factors impacting the adoption of digital instructional technology in this district are external pressures, stakeholder priorities, financial feasibility, and educational factors. These themes were often viewed in conjunction with one another. Ultimately, financial feasibility is the gateway for approval and adoption of every digital instructional technology initiative. Stakeholder priorities framed by external pressures as well as educational factors are equally strong driving influences affecting technology adoption over the past thirty years.

Summary of Chapter Four

This chapter began with a historical overview of the evolution of digital instructional technology over a thirty year timeframe in one district. Data was compiled from historical documents and substantiated via interviews with staff. This data was structured in three researcher-defined eras. Each era had its own struggles and successes. Many factors contributed to as well as impacted the scope of the adoption of digital instructional technology in the district in each era and were identified as: external pressures and influences, stakeholder priorities, financial feasibility (opportunism), and educational factors. These themes were often viewed in conjunction with one another. Ultimately, financial feasibility framed the opportunity and ultimate gateway by which approval and adoption of every digital instructional technology initiative is obtained. Stakeholder priorities framed by external pressures and influences as well as educational factors were also identified as equally strong driving influences affecting technology adoption over the past thirty years.

Chapter Five

Teachers and Technology: Findings and Data Analysis

In this chapter I present analysis of data collected via a survey of veteran teachers having taught in the district at least twenty-five years augmented with follow-up interviews of selected staff to address research questions three, four and five. This chapter continues the conversation started in chapter four and discusses teachers' extent of use of digital instructional technology, factors influencing teachers' use of digital instructional technology and the perceived benefits of use.

Research Question #3: To what extent do teachers use available digital instructional technology?

Varying digital instructional technology devices were available to classroom teachers during the three researcher-defined eras. The extent to which teachers first began to use the available technology during each era is depicted in Figure 5.3.

At what point in your career with this district did you first begin to regularly integrate available digital instructional technology in your classroom?

		Response	%
1984 - 1993		34	55%
1994 - 2003		15	24%
2004 - Present		11	18%
I do not regularly integrate digital instructional technology.		2	3%

N = 62

Figure 5.3 Initial Use of Digital Instructional Technology in Classroom

Over half of the veteran teachers surveyed began to integrate available digital instructional technology during the first denoted era (1984-1993). The least represented era was the most recent era, accounting for nearly one-fifth of all teachers surveyed. Figures 5.4 through 5.6 elaborate on the type of devices used by teachers in each of the researcher-defined eras.

During the timeframe 1984-1993, which of the following types of digital instructional technology did you regularly use in your classroom for instructional purposes?

		Response	%
Apple Desktop Computer		28	47%
Audio Tape Recorder		39	65%
Filmstrip Projector		39	65%
Overhead Projector		50	83%
Laser Disk Player		9	15%
Radio or Educational Television		26	43%
Other		8	13%

N = 62 (Other responses included a Newton, slide projector, TRS-80 computer, and opaque projector)
Figure 5.4 Device Use: 1984-1993

As shown in Figure 5.4, the most commonly-used digital instructional technologies used by the survey respondents during the first era (1984-1993) were the overhead projector (83% of respondents), filmstrip projector (65% of respondents) and the audio tape recorder (65% of respondents). The Apple desktop computer as well as educational radio or television was also used by approximately half of those responding.

During the timeframe 1994-2003, which of the following types of digital instructional technology did you use regularly use in your classroom for instructional purposes?

		Response	%
PC Computer		50	81%
Apple Desktop Computer		13	21%
Laptop Computer		15	24%
Palm Pilot		12	19%
Interactive Whiteboard		15	24%
Digital Video Projector		15	24%
VHS Player		54	87%
DVD Player		43	69%
Other		8	13%

N = 62 (Other responses included an electronic note taking device, heart rate monitor, CD player, slide projector, digital camera and video recorder)
Figure 5.5 Device Use: 1994-2003

Figure 5.5 identifies the most commonly-used digital instructional technologies used by the survey respondents during the second era (1994-2003) as being the desktop personal computer (81%) and the VHS player (87%). The DVD player was also used by nearly seven out of ten veteran teachers during this timeframe.

In the years since digital classrooms became a standard for all classrooms in this district (2004-2014) which of the following types of technology have you regularly used and integrated in your classroom for instructional purposes?

	Response	%
Windows Laptop Computer	35	57%
Classroom Response Systems	21	34%
Palm Pilot	12	20%
Apple Laptop Computer	10	16%
PC Desktop Computer	51	84%
Digital Video Projector	37	61%
VHS Player	39	64%
DVD Player	56	92%
Wireless Keyboard/Mouse	34	56%
Digital Annotation Device	36	59%
iPad or Tablet Computer	21	34%
Other	11	18%

N = 62 (*Other responses included a document camera, heart rate monitor, iMac Desktop computer, video recorder and iPhone)*

Figure 5.6 Device Use: 2004 – Present

Figure 5.6 depicts instructional technology use in the final era from 2004-2014. The device most frequently used is the DVD player, which jumped from 69% usage in the previous era to 92% in this time period. Personal desktop computers were used by 84% of participants, followed by Windows laptop computers used by 57% of teachers. The least used digital instructional device in this era was an Apple laptop computer.

Survey participants were asked to identify digital instructional technology devices they never used in their classrooms. Figure 5.7 provides their responses.

Which (if any) of the following types of digital instructional technology tools have you NEVER chosen to use regularly at any point over the duration of your career with this district?

	Response	%
Classroom Response Systems	31	53%
Palm Pilot Handheld Computers	39	67%
Digital Annotation Devices	24	41%
Wireless Keyboard and Mouse	11	19%
Document Camera	18	31%
Digital Video Projector	9	16%

N = 62

Figure 5.7 Non-used digital instructional technology tools

The device identified by 67% of teachers as never having been used was the Palm pilot hand-held computer. This tool was not available to all teachers at all grade levels, thus this high response rate may be due to circumstances outside of the teachers' technology preferences. Classroom response systems were not used by over half of the surveyed teachers; these instructional tools were available in all school buildings at all levels though they were shared between classrooms. The digital annotation device was not used by 41% of respondents. This device was provided to every classroom teacher at all levels. This signifies a substantial financial investment by the district that was not utilized by a large portion of the veteran surveyed classroom teachers.

The survey asked veteran teachers to self-identify their tendency to adopt and integrate digital instructional technology in their classrooms. Figure 5.8 depicts their responses.

In general, how would you describe your adoption and integration of digital instructional technology over the duration of your career with this district?

		Response	%
Quick to adopt any new technology in the classroom.		24	39%
Usually wait to adopt new technology with the "majority" of other teachers.		34	55%
Tend to be with the group of teachers that is last to adopt new technology in the classroom.		3	5%
In general, I do not integrate technology in the classroom.		1	2%

N = 62

Figure 5.8 Self-reported tendency to adopt and integrate new technologies

The majority of survey respondents (55%) prefer to wait to adopt new technologies until it has been adopted by the majority of other teachers. This corresponds to the diffusion category associated with early to late majority adopters as defined by Rogers (1995). As suggested by Earle (2002), successful technology integration is not defined by the frequency of use but rather by the nature and quality of its use. Hence, becoming a good adopter is more important than a first adopter or a frequent adopter. These thirty-four veteran teachers who are more likely to delay adoption are not precluded from being successful adopters and users of the instructional tool. Only one participant self-identified as not using technology in the classroom at all.

Survey participants were asked about the frequency of use of given digital instructional technologies. Figure 5.6 depicts their responses.

For each digital instructional technology listed below, indicate your current frequency of classroom use for instructional purposes.

	Frequent (Two or more times per week)	Somewhat Regularly (several times per month)	Infrequent (Not on a regular basis)	Do Not Use
Digital Projector	35	9	9	7
Interactive Whiteboard	23	5	11	21
Document Camera	8	11	18	23
Desktop or Laptop Computer	57	1	1	1
iPad or Tablet Computer	15	9	10	26
Student Response System	3	9	16	32
Video or Still Camera	12	15	22	11

N = 60

Table 5.6 Frequency of technology device use

The most frequently used device was the desktop or laptop computer, which are available to all teachers district-wide; fifty-seven respondents use it frequently, one uses it somewhat regularly, one uses it infrequently, and one does not use it at all. Digital projectors are the next most-frequently used device (thirty five participants), followed by interactive whiteboards used by twenty-three teachers. The least used device for surveyed teachers were student response systems. Over half of surveyed teachers (thirty-two) do not use this available technology device.

Summary of research question #3: extent of teacher use of digital instructional technology. The extent to which veteran teachers utilize available technology in the classroom varies greatly. Over half of the surveyed teachers adopted instructional technology between the years 1984-1993. While this denotes the slight majority of surveyed teachers, availability of digital instructional technology in the district’s classrooms varied during the “Beginning Years” era, and so lack of use may be due to lack of access. An analysis of specific digital instructional devices used by veteran teachers in each era illustrates the use of the most prominent and accessible devices of the time period. For example, during the “Model School” era, the most widely used devices were those being purchased and placed in model school classrooms (i.e.

VHS, Personal computer and DVD players). Likewise, during the "Digital Classroom" era, the use of these same devices remained prominent as these became the standardized tools in all classrooms across the district.

Of equal importance to the study is an examination of the devices surveyed veteran teachers chose not to use with regularity in their classrooms. The three least used devices were the Palm hand-held computer, student response systems, and digital annotation devices. While all teachers did not have access to Palm computers, each building was provided a standard number of student response systems. Every classroom district-wide was equipped with digital annotation devices. The fact that these two digital instructional technology tools were reported as not used illustrates allocated funds for standardizing technology may not have been the best decision. Unused technology cannot impact teaching or learning.

Surveyed teachers self-identified their proclivity to adopt digital instructional technology tools. Over half aligned themselves with the "late majority" category of innovation adoption; that is, they wait until the majority of other teachers have tried a new innovation before opting to adopt it themselves. This points to mimetic behavior whereby a person is influenced by the behaviors of those around them. Finally, as era of use and frequency of use have been explored, surveyed teachers were asked to report the frequency of use of specific digital instructional technology tools. Overwhelmingly, ninety-five percent of teachers report using desktops or laptop computers frequently in the classroom. Digital projectors were used frequently by fifty-eight percent of teachers, while the least used digital instructional technology tool was the student response system at only five percent reporting frequent application. Research question number three paves the way for a deeper exploration of the factors contributing to teacher's use in question number four.

Research Question #4: What factors influence a teacher's decision to use available technology?

After exploring the extent of use of digital instructional technologies in research question three, research question four asks, "What factors influence a teacher's decision to use available technology?" This research question seeks to explore in-depth the influence of outside factors that either promote or inhibit the use of digital instructional technologies. As technology tools represent large monetary and time investments by the district, every possible effort should be made to improve the likelihood of their use in the classroom. Table 4.7 illustrates the extent to which given factors influenced a teacher's use of digital instructional technology. Responses were collected via the electronic teacher survey.

Table 5.7
To what extent do or did the following factors influence your decision to use digital instructional technology in your classroom? (1= No Influence, 2 = Moderate Influence, 3 = Strong Influence)

Factors Influencing Decision to Use Digital Instructional Technology

	Average Value	Standard Deviation
Ease of Use	2.53	0.65
Availability of Device	2.72	0.49
Level of Training Provided	2.25	0.68
District-Driven Initiative	2.07	0.69
Personal Technology Interest/Proficiency	2.47	0.54
Collegial Pressure	1.53	0.62
Impact on Student Engagement and/or Student Learning	2.73	0.52
Dependability of Device/Technology Support	2.52	0.68
Makes Job/Tasks Easier	2.52	0.60

N=60

According to the sixty surveyed veteran teachers, the factor influencing the decision to use digital instructional technology the most was the impact on student engagement and/or student learning. This factor received the highest score on the three-point scale and a small standard deviation denoting statistical agreement in responses. In a close second, surveyed teachers responded that availability of the device was very important in their decision to use a device. The third most impactful factor is the ease of use of a device. The factor giving the least impact on a teacher's decision to use a device or tool was collegial pressure. This was clearly the lowest scoring of the given contributing factors with a mean score of 1.53 out of a three-point scale. This points to a minimal impact of collegial or mimetic pressure according to the perceptions of the surveyed veteran teachers.

The seven teachers interviewed were asked to describe factors that influenced their use of digital instructional technologies. Their responses aligned to five distinct themes: (1) input on device selection, (2) technology availability and reliability, (3) training and professional development, (4) ease of use/efficiency, and (5) expanded educational opportunities.

The interviewed teachers expressed a desire to be involved in the decision-making process of adopting digital instructional technologies. When left out of decisions, there was a distinct lack of "ownership in the decision," as stated by MIDDLE1. She continues, "I wish they would have given a checklist of, 'is this what you would use?' I wish they would have said, 'these are the things that are available to you. What do you see yourself as using?'" HIGH3 referred to a classroom television initiative as "a boondoggle to say the least…a colossal waste of money as were the little hand-held things." This teacher reflects on how he would like to have seen the district handle technology adoptions: "I would have, I guess, I would have asked the opinion of classroom teachers, take a random sampling and said, 'this is what we're looking at. Will it fit your need?' Another digital instructional technology used rarely by teachers was the digital annotation device. Said HIGH2: "Didn't ever use them. I wish someone would have asked before they gave them to us because I think that very few of the English teachers I knew used them. Sometimes I think that we're given technology that we don't use, we can't use, or it's just not an effective teaching tool." These sentiments sum up the first underlying theme influencing a teacher's use of technology: teachers resent being left out of the decision-making process, they desire a voice and ownership in determining their resources, and the standardized method of equipping all classrooms with the same equipment resulted in many unused devices and wasted tax dollars.

Teacher technology use was influenced by technology availability and reliability. Limited financial resources can constrain the availability of digital instructional technologies in schools. ELEM1 teaches in a school with two computer labs and no student classroom computers: “We have those two computer labs, but we can’t get into them because the upper grades have them most of the time. Then when testing comes, you are definitely out.” Similarly, the school in which ELEM1 teaches has several classroom sets of student response systems. There is a challenge of availability: “The clickers seem to work, but there’s typically a teacher at a grade level that uses them a lot. So scheduling and trying to figure out when you can use them, when they’re not using them, coming up with some kind of plan. Sometimes it’s just easier to not use it because it gets too complicated.”

When teachers plan to incorporate digital instructional technologies in a lesson, they desire assurance that the devices will operate as needed. Reliability of laptops has been a frustration to ELEM3:

> There were many times that was a frustration because they couldn’t get logged in. The laptops have been very challenging in this manner. Having to turn them off, having to take out the battery, they get on and then they get kicked off…They spend their whole twenty minutes trying to get logged on and then their time’s up. They get frustrated because they didn’t get to have their time, and I’m frustrated because that was supposed to be their work time while I was working with this student. That’s always been an issue.

Internet connectivity is a challenge for MIDDLE1 and prevents her from eagerly utilizing wireless laptops in her classroom. She said, “in years past, it has been hard for laptops to be reliable, not finding the wi-fi. Depending on which room you were in, the farther you were away from the router, the harder it was.” Availability (access to) digital instructional technologies and reliability of functionality are two reasons that teacher adoption of technologies may be hindered.

The amount and quality of professional development training influenced a teacher’s decision to utilize digital instructional technologies. As the use of instructional technologies increased, so did the necessary training. ELEM2 states, “You have to have training, and the training will be on your own time. There will be no stipend, there was no payment for this.” ELEM1 underlies the importance of high-quality training opportunities:

> That’s because typically there’s not a lot of training, professional development, good suggestions. Like you could do this, you could do this, you could do this. Okay, now why don’t you go back to your schools and figure out what you’re going to do. Depending on your age and how familiar you are with technology that may not happen at all because you don’t even know what to do.

The district once employed Technology IRTs (Instructional Resource Teachers) for every five buildings to provide training on instructional tools and on-going support. HIGH1 describes the challenge of providing quality professional development and training once the Tech IRT positions were dissolved due to budget cuts: “I think we’ve taken a backslide with it (professional development) since they don’t have Tech IRTs anymore. There’s not, I mean, trainings now taken on-board by the buildings, and I think some buildings do it better than others…It’s a time piece for teachers to bring on new technology and embed it (training) into that.” MIDDLE2 shared her opinion about why technology use by teachers is limited: “I mean well, part of the, part of the reasons why even today teachers don't use technology is the lack of information on how to use the technology. I've been to three Moodle seminars and I still don't know what the hell I'm doing." This communicates that quality professional development that meaningfully impacts teachers' work in the classroom and includes a system to provide on-going support and training are essential for effectively deploying digital instructional technologies.

Teachers are often drawn to adopt an instructional technology due to its ease of use and the benefit of efficiency it brings to their instruction. Seven veteran teachers were interviewed, and several expressed ease of use as a contributing factor to their decision to utilize particular digital instructional technologies. MIDDLE1 describes the transformational nature of technology on her teaching: "I think just making it easier to teach and not being stuck in a particular square in your classroom." Likewise, ELEM3 describes the use of the AirLiner to allow teachers to walk around the room projecting the visual display on the smart board: "I left that AirLiner right there on the cart. I used it and fell in love with it. I thought it was so cool because I could walk around and I wasn't tied to my desk. I was writing on the AirLiner and the kids were all responding to that. They thought that was really cool." Student response systems, or 'clickers,' are referenced by HIGH1 as providing efficiency in grading student responses automatically. This is a benefit for the teacher to provide instant feedback to students. HIGH1 further elaborates about other digital instructional technologies: "I don't know when the digital projectors and stuff came out, but that's been a wonderful, wonderful thing."

Digital instructional technologies can expand educational opportunities by making learning unique, inventive, and interactive. ELEM3 describes the expanded breadth of topics covered, whereas without technology… "I would be limiting what I could expose them to. I think it just makes my job easier. There are parts of it, facets of it that makes the teaching piece easier." HIGH1 describes the impact of digital instructional technologies on students: "Students access to knowledge, access to any information, anywhere, anytime…it has to be for the students." She emphatically asserts an example of how digital instructional technology has enhanced her teaching ability:

> Oh my gosh, I can be five times the teacher, or ten times, or one hundred times the teacher with the technology. It used to be standard procedure for an Open House for me to show a little bit of the technology to the parents. One of the things I would always show is the DNA and the strength of DNA, and how I can talk to the kids about it and it sounds complex. And then you flip up on a screen on the Internet and you take a 3D image of it, and you can rotate it around. Then you can zoom in on just one nucleotide, and you can talk about that. And it just simplifies things to the point that there's no way that you can talk and lecture and get that across to the kids without it (technology).

Similarly, when asked about the significant impact of technology on teaching, ELEM1 shared: "I would probably say being able to bring the Internet into the classroom. We're having a discussion and the students ask me a question and I don't know, 'hey, let's look on the Internet. Let's see what we can find for an answer. Plus, bringing the world into the classroom is a great benefit."

Summary of research question #4: factors influencing teacher use. Survey results from veteran teachers identified the following three top influences on teacher use of digital instructional technologies: (1) student engagement, (2) availability, and (3) ease of use. These three themes were also contained within the seven interviews and resulted in these respondent themes: (1) input in the selection of devices, (2) availability and reliability, (3) professional development and training, (4) ease of use, and (5) expanded educational opportunities. All of these factors can shape a teacher's decision to use or discontinue use of a digital instructional technology.

Research Question #5: What are the perceived benefits of the various digital instructional technologies adopted according to teachers?

The large financial and time investment required by digital instructional technology initiatives makes meaningful benefits important and perceived effectiveness from teachers a priority. Research question five asks: "What are the perceived benefits of the various digital instructional technologies adopted according to teachers?" Data for this question were gathered from both survey and interview questions. Teachers were first asked via survey to rate the perceived effectiveness of specific digital instructional technology tools at meeting three research-stated benefits of instructional technology: improving delivery of instruction, student engagement, and student achievement. Tables 5.8 through 5.10 depict veteran teacher responses from the survey in these three areas.

Table 5.8
On a scale of 1 to 5 (1 = perceived effectiveness is low; 5 = perceived effectiveness is high), indicate your belief in the strength of perceived effectiveness of each digital instructional technology as it impacts the three areas listed below.
Improved Delivery of Instruction

	1	2	3	4	5	Mean	Standard Deviation
Digital Projector	3	1	10	9	31	4.19	1.15
Interactive Whiteboard	10	6	14	3	21	3.35	1.54
Document Camera	13	4	12	11	14	3.17	1.51
Desktop or Laptop Computer	3	1	5	7	38	4.41	1.11
iPad or Tablet Computer	6	3	14	7	24	3.74	1.38
Student Response System	19	6	15	9	5	2.54	1.37
Video or Still Camera	5	13	13	9	14	3.26	1.33

N=60

Teachers rated the desktop and laptop computers as the most effective digital instructional technology tool to improve delivery of instruction with an average score of 4.19 on a five point scale. Digital projectors and iPad/tablets were the second and third highest scoring devices to improve instructional delivery. The device perceived to be the least effective at aiding the delivery of instruction was the student response system, scoring only a 2.54 average on a five-point scale.

Table 5.9
Increased Student Engagement

	1	2	3	4	5	Mean	Standard Deviation
Digital Projector	2	3	14	10	25	3.98	1.14
Interactive Whiteboard	8	5	12	7	22	3.56	1.48
Document Camera	16	4	13	8	13	2.96	1.55
Desktop or Laptop Computer	2	3	7	6	36	4.31	1.13
iPad or Tablet Computer	6	2	11	11	24	3.83	1.34
Student Response System	14	7	12	9	12	2.96	1.50
Video or Still Camera	5	10	14	10	15	3.37	1.32

N=60

Table 5.9 depicts survey responses about tools that effectively increase student engagement. The most effective digital instructional technology at improving student engagement was also the desktop or laptop computer. Digital projectors and iPad or tablets are again the second and third most effective tools at increasing student engagement. The least effective devices according to surveyed teachers at increasing student engagement are document cameras and student response systems.

Table 5.10
Increased Student Achievement

	1	2	3	4	5	Mean	Standard Deviation
Digital Projector	3	2	17	11	21	3.83	1.16
Interactive Whiteboard	10	8	11	6	19	3.30	1.54
Document Camera	17	5	11	8	13	2.91	1.58
Desktop or Laptop Computer	4	1	9	7	33	4.19	1.23
iPad or Tablet Computer	7	1	14	9	23	3.74	1.38
Student Response System	17	9	14	9	5	2.56	1.34
Video or Still Camera	6	12	15	12	9	3.11	1.25

Surveyed teachers perceive desktops and laptops, digital projectors, and iPad and tablets as being the top three digital instructional technologies to increase student achievement. These top three devices align with the previous two responses, denoting a clear sentiment from surveyed teachers that these three devices are the most impactful technology tools. They are also three of the top four devices used by teachers with great frequency, as self-reported on research question three. Again, the device with the perceived least impact on student achievement is the student response system. Very small pockets of primarily high school teachers still utilize student response systems for formative and summative assessments. Overwhelmingly, student response systems are used the least of all available technologies in the district, as depicted on the response to research question three where only three of sixty teachers self-reported using these devices with any frequency for instruction.

Table 5.11
How would you describe your beliefs regarding digital instructional technology?
Beliefs Regarding Digital Instructional Technology

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree	Mean	Standard Deviation
I believe technology functions as an effective tool for helping students master the state academic content standards.	24	25	3	2	0	1.69	.75
I believe the use of technology makes the process of learning more interesting for students.	34	18	2	0	0	1.41	.57
I believe the use of technology saves me time on routine tasks.	24	17	8	5	0	1.89	.98
I believe technology improves the effectiveness of my teaching.	27	18	5	3	1	1.76	.97
I believe technology makes my job more interesting.	26	21	4	2	1	1.72	.90
I don't believe technology significantly impacts my teaching.	4	5	6	20	19	3.83	1.22
I don't believe technology significantly impacts student learning.	1	1	6	22	24	4.24	.87
I believe funds spent on technology are appropriately allocated.	8	25	13	6	2	2.43	1.00
I believe funds spent on technology are necessary expenditures.	28	21	4	1	0	1.59	.71

N=54

Table 5.11 provides data on nine statements about digital instructional technology and the extent to which teachers believe the statement is applicable to them. The statement receiving the highest number of participants in agreement, in both the category “Strongly Agree” alone (thirty-four) and in “Strongly Agree” and “Agree” combined (fifty-two) is, “I believe the use of technology makes the process of learning more interesting for students.” The two statements that received the next highest-degree of consensus are, “I believe funds spent on technology are necessary expenditures,“ and “I believe instructional technology functions as an effective tool for helping students master the academic content standards.” Forty-nine of the responding fifty-four teachers agree or strongly agree with each of statements. The statement agreed with by the least number of teachers is (two), is, “I don’t believe technology significantly impacts student learning.”

Table 5.12
How would you describe your beliefs regarding digital instructional technology?
Beliefs Regarding Technology’s Impact on Teaching – Disaggregated by Initial Use Era

		How would you describe your beliefs regarding digital instructional technology? - I don't believe technology significantly impacts my teaching.				
		Strongly Agree	**Agree**	**Neither Agree nor Disagree**	**Disagree**	**Strongly Disagree**
At what point in your career with this district did you first begin to regularly integrate available digital instructional technology in your classroom?	**1984 - 1993**	0 0%	4 14.81%	2 7.41%	10 37.04%	11 40.74%
	1994 - 2003	2 13.33%	0 0%	2 13.33%	6 40%	5 33.33%
	2004 - Present	1 10%	1 10%	1 10%	4 40%	3 30%
	I do not regularly integrate digital instructional technology.	1 50%	0 0%	1 50%	0 0%	0 0%

N= 54 *Ten teachers did not respond to the question related to beliefs regarding digital instructional technology.*

Early in the electronic teachers’ survey, teachers were asked to select the era in which they first began integrating the available digital instructional technology in their classrooms. The response choices aligned to the three researcher-defined eras used throughout data analysis in Chapter Four: 1984-1993, 1994-2003, 2004-2014. Teachers were later asked to what extent they agree with the following statement: "I don't believe technology significantly impacts my teaching." Table 5.12 disaggregates responses to this follow-up question according to their previously-identified era of first technology use. Over forty percent of teachers who first adopted technology in their classroom from 1984-1993 strongly disagree with the statement postulating the non-impact of instructional technology on their teaching. Teachers in the 1993-2004 era of first adoption strongly disagree at a rate of thirty-three percent, while the most recent era adopters strongly disagree at a rate of thirty percent. This suggests that the longer a teacher has utilized digital instructional technologies in one's classroom, the greater the perceived impact of these technologies on the effectiveness of their instruction.

The second data source used to answer research question five was the analysis of teacher interviews. Three themes emerged from the responses: (1) Access to Information, (2) Student Engagement and (3) Efficiency.

Access to Information. Increased access to information for both students and teachers was identified as an overarching theme among the reasons provided as benefits for using digital instructional technology by teachers interviewed. HIGH1 argues increased access to information is a way to provide differentiation for students as well. He explains,

> Well, again, effective differentiation is a result of increased access to information. You've just got to be able to do that. We were talking about Truman Capote because we were going to read *In Cold Blood*. I said, "I'm going to give you some interviews with Truman Capote." So, we went to YouTube and there's an interview with Dick Cavett interviewing Truman Capote. So, they got to see what this guy was really like. How can

> you get that from solely a book? Then they read the novel and I showed them the movie, not all of it, parts of the movie In Cold Blood. But, I then also showed them part of a movie that is about Truman Capote. It was interesting and engaging for them see because this is "Wow!" this is how the director saw him. So, now you have to take those three views and develop your own. What's this guy like?

HIGH2 concurs, "It's all about the visual. It takes the most boring lecture ever, say about frogs, and all of a sudden it becomes a high school student realizing he can identify frogs by their visual appearance and movement and sound. It's nothing like just seeing a picture in a book. The added benefit of massive amounts of information just wasn't there before technology." ELEM1 states, "You just don't have to hunt for anything anymore, like go find a CD or something with what you need. I don't and the kids don't. It's there on the web. It's like a million sets of encyclopedias right there at our fingertips."

Student Engagement. Increased student engagement was also identified as an overarching theme among the reasons touted as a benefit for using digital instructional technology by teachers interviewed. The use of digital instructional technology is "all about engagement" states HIGH1. "It's giving kids that maybe wouldn't have had the opportunity, the opportunity to succeed." Even the teacher most skeptical, of those interviewed, regarding the use of technology in the classroom (ELEM2) agrees that technology has an impact on student engagement in her classroom. "I don't really take advantage of a lot of it. I just think we spend a lot of time making things cute when they don't have to be. But, that said, I do love the kids being able to instantly visualize what I'm trying to teach when I use the document camera. They can bring up their paper and just put it underneath there. They are proud of what they can share and I think it is in fact engaging them in a better way."

Student engagement equates to interest as ELEM1 describes, "The kids are always asking to be the next in line at one of our three laptops in the classroom. There is always a long list on the board of students wanting to use technology – be the next one in line. That to me says it's an engagement piece. It's incentive. They want to use it." The responses by surveyed teachers as shown Table 5.11 reinforce this strong belief by teachers as indicated by the response rate to the statement "*I believe the use of technology makes the process of learning more interesting for students*." No teacher disagreed with this statement and all but two teachers strongly agreed or agreed.

Efficiency. Efficiency emerged as a theme with a multi-faceted meaning by both interviewed and surveyed teachers. ELEM1 defines the benefit of efficiency stating, "You just flat out can get more done. Like for example grades and how we used to do that. It makes us more efficient in our jobs." HIGH1 discusses efficiency from a different perspective. He provides this example.

> If you walk into my classroom you would think I'm the worst teacher there is. But what you don't understand is that these students, and it's on a spreadsheet, have forty-five tasks to complete during the quarter. All of the lectures, whether there's fifteen or twenty of them. They watch at home so when they come into the classroom, here is one student working on this area, here's another student there on that area, and here's maybe some students who are doing individual work. I'm just going around answer questions, and there could be several different things going on. It's more efficient. Kids are moving at their own pace and we are covering more information for everyone. No one is held back. That's efficiency in teaching and in learning.

ELEM3 says, “I just fell in love with the Airliner Slate. I know some teachers haven’t. But, I can walk around the room or be standing right beside a student in class and be writing on the screen. Kids think that’s cool for one. But, it saves me time and makes the whole classroom management thing more efficient. You know, proximity and that.” The surveyed teachers concur in their belief that efficiency is gained through the use of technology as indicated by forty-one of fifty-four teachers’ belief that the use of technology saves time on routine tasks.

Summary of research question #5: perceived benefits of digital instructional technologies. Three themes were identified within the interview responses: (1) access to information, (2) student engagement, and (3) efficiency. Additionally, survey results from veteran teachers in the district concur showing their belief that student engagement is increased and efficiency is gained when using digital instructional technology in the classroom. These three perceived benefits can shape a teacher’s decision to use or discontinue use of a digital instructional technology.

Summary of Chapter Five Findings

Technology fills a variety of needs for teachers. The extent to which veteran teachers utilized available technology in the classroom over the past thirty years has varied greatly and has been impacted by multiple factors and influenced by the perceived benefits of their use. An analysis of specific digital instructional devices used by veteran teachers in each era illustrates the use of the most prominent and accessible devices of each researcher-defined time period, i.e., during the “Model School” era, the most widely used devices were VHS players, Personal computer and DVD players. Additionally, during the “Digital Classroom” era, the use of these same devices remained prominent as these became the standardized tools in all classrooms across the district. Equally important to the study was an examination of the devices surveyed veteran teachers choose not to use with regularity in their classrooms. The three least used devices by veteran teachers were the Palm hand-held computer, student response systems, and digital annotation devices. The focus of the district to equip every classroom district-wide with digital annotation devices could be identified as an ill-informed and costly decision as any unused technology doesn't have a chance of impacting teaching or learning.

A deeper exploration of the factors contributing to teachers' use identified three major influences to teacher use of digital instructional technologies: (1) student engagement, (2) availability, and (3) ease of use. These three themes were also contained within the interview respondent themes: (1) input in the selection of devices, (2) availability and reliability, (3) professional development and training, (4) ease of use, and (5) expanded educational opportunities. The totality of these factors contribute to the shaping of a teacher's decision to use or discontinue use of a digital instructional technology.

The underlying themes identified as benefits to teacher use of digital instructional technology from within the interviewed teachers' responses were: (1) access to information, (2) student engagement, and (3) efficiency. Moreover, survey results from veteran teachers in the district concurred with this finding that student engagement is increased and efficiency is gained when using digital instructional technology in the classroom.

Chapter Six

Discussion and Implications

This study explored the evolution of digital instructional technology in a suburban Kansas school district over a period of thirty years. The study included an examination of specific technologies adopted by the chosen district, factors influencing the district's adoption of various technologies, the extent of teachers' use of technologies, factors influencing their use, and, perceived benefits of the use of digital instructional technology. Previous research includes an exploration of the use of technology in the classroom and varying theories regarding factors impacting a teacher's decision to adopt, as well as technologies and their impact on student achievement. The general body of literature on the topic of digital instructional technology lacks a thorough investigation as how technology decisions and adoptions evolve in a single district over a period of time. This study focused on how digital instructional technology has evolved in a single district from the initial adoption of digital classroom technology to present – a period of thirty years. With the continual introduction of new and innovative digital instructional technology tools and the importance of making prudent adoption decisions of such technologies, the following research questions were addressed in this study to target this gap of knowledge:

1. How has digital instructional technology evolved over the past thirty years in one district?
2. What have been the key factors influencing a district's adoption or non-adoption of digital instructional technology innovations?
3. To what extent do teachers use available digital instructional technology?
4. What factors influence a teacher's decision to use available digital instructional technology?

5. What are the perceived benefits of the various digital instructional technologies adopted according to teachers?

This chapter provides conclusions, limitations, policy considerations, and recommendations for future research surrounding the topic of the adoption of K-12 digital instructional technology.

Conclusions

After synthesizing data from all sources and analyzing for themes, there are six primary findings from this research study:

1. Digital technologies adopted by the district over a period of thirty years are in varying stages of use as a result of multiple factors.
2. Equity and standardization was an overarching contributor to many digital instructional technologies being adopted in this district.
3. Financial feasibility (opportunism) played a large role in the adoption and deployment of multiple technologies over the defined years of this study.
4. External pressures and influences were at play in all of the user-defined eras with respect to the selection and adoption of digital instructional technologies in this district.
5. Teacher beliefs surrounding the benefits of digital instructional technologies may be impacted by the teachers' non-involvement with the decision-making process for such technologies and impact teachers' frequency of use/nonuse.
6. Digital instructional technology adopted by this district has been in large part targeted at improving teacher instruction as guided by various stakeholder priorities.

The first finding of this study is digital technologies adopted by the district over a period of thirty years have either failed, been replaced, persist to this day, or are now in an emerging status; and as such, the state of each digital instructional technology is a result of multiple factors. I provide an analysis of various digital instructional technologies in each of these categories during the past thirty years in this district.

Failed Digital Instructional Technologies. A few of this district's technology decisions are by both administrators and teachers to be at some degree a failed adoption. Staying at the cutting-edge of technology innovations and deployments without being at the bleeding-edge has been a concept learned the hard way by this district with a few device deployments. One technology leader underscores this by commenting, "I mean I think the Palm initiative is a perfect example of stepping out too soon into something that really wasn't ready for that kind of deployment. We had good intentions. It could have worked out just fine, and we might still be running that platform if they had developed what Apple has developed into the iPad. I don't think we need to be on the cutting edge with everything. It has come back to bite us sometimes and did in this instance." Another digital instructional technology implementation which district technology leaders feel has been a failed initiative is that of the attempt to duplicate a costly television studio at a second high school in an attempt to appease community dissatisfaction. Technology leaders directly responsible for making decisions at this time were not anxious to admit their mistake for failed adoptions. District leaders involved in these decisions gave differing views than district leaders in the same positions currently. Further, some decisions made top-down did not persist or have been replaced.

Replaced Digital Instructional Technologies. The CPS units purchased in large quantities by the district have been replaced by online web applications which provide the same type of functionality and don't require a proprietary device in the hands of students. These devices were never used to their full capacity with some units never used – "collecting dust on the shelf", as stated by E2. Upgraded software operating systems have resulted in antiquated devices such as the older CPS units that can no longer run on the newer desktops and laptops in the district. The district purchase of CPS units has not been cost effective. Furthermore, this device was self-reported by teachers surveyed and by those interviewed as being the least used by teachers as well as having the least impact on student achievement and engagement. Additionally, the Laser PC5 laptop computers purchased for larger elementary schools were soon replaced by traditional laptops. As TECH2 reiterated, “The kids weren’t interested in them and we bought a million of them. We should have got student buy-in and we didn’t. We’ve done that a few times.” Finally, the IIPC Carts of the second user-defined era were replaced with a digital projector in all district classrooms, providing a larger viewable projection with increased resolution. The digital projectors were identified as one of the top digital instructional technologies impacting delivery of instruction as well as student engagement and achievement.

Persisting Digital Instructional Technologies. Multiple digital instructional technologies have persisted over the period studied. The most notable are the desktop and laptop computer, as once introduced in classrooms across the district, have not been replaced by another tool, though they have of course needed to be replaced with newer models sufficient to operate new applications and run new operating systems. However, as such, sustainability has continued to be a concern. As T3 stated, “Sustainability is a big worry for me, always has been. It’s not like furniture that’s going to last 20 or 25 years. It’s got to be replaced every four to six years at the least. So sustainability is a big deal.” Another example of the persistence of digital instructional technology and one that was identified by surveyed and interviewed staff alike as having the most impact on delivery of instruction as well as being the most frequently used and having the most impact on student engagement and achievement is the digital projector. The sustainability of this device is also an issue of concern as the cost of a bulb is approximately

$300 each. The persistence of digital instructional technology comes with a price - that of continued cost to the district and the overarching worry regarding sustainability.

Emerging Digital Instructional Technologies. Emerging technologies continue to be investigated by the district. The district seems to have an understanding of the importance of not repeating failures of the past as they work toward garnering teacher input into adoptions of the future. T2 states: "It is a high priority just to investigate and make sure that we are spending wisely which I think we've done a phenomenal job in the last year. Yes, it's taken us a year, but we looked for a year before we made the decision to spend $6 million at the elementary level. I think that was a good decision. High priority is to just make sure that the teachers and the students have what the taxpayers have wanted to give them."

The second finding of this study is equity and standardization have been an overarching contributor to many digital instructional technologies being adopted in this district. From the earliest of implementations and the establishment of model schools, the district sought to equip all classrooms at each level (elementary, middle, high) with the same technology in an effort to achieve equity and standardization. While in theory this sounds like a worthy goal, it has in fact resulted in purchases of digital instructional technology that were not deemed needed by teachers and as a result were not used, thus resulting in no chance of impact on student achievement or engagement. Looking to the future, TECH2 underscores the importance of understanding this component - both the pros and cons, stating:

> Are we going to just flat even the playing field for everybody and say you all get this device and we're all on the same field...That's what probably concerns me the most about BYOD. Teachers that are not so tech savvy having to deal with a variety of different device types that come into the classroom and trying to make

something that they want to use work. I think that's going to be a challenge, I really do.

Additionally, the digital annotation device, a component of the standardization of all digital classrooms across the district, was identified both over half of the surveyed teachers as either being very infrequently used or not used at all. Thus, while the goal of standardizing the type of digital instructional technology and providing equity of access in all classrooms, the technology remained in large part unused by a majority of teachers, and at a significant cost to the district.

The third finding of this study is financial feasibility played a large role in the adoption and deployment of multiple technologies over the defined years of this study. This district was a growing district in student population for the entire thirty year period studied. As such, the district had multiple successful bond elections to fund new needed school buildings. As new buildings were built approximately every three years, this provided a convenient way for the district to add on a technology component to most bonds to provide additional digital instructional technologies to the district's classrooms. It also provided a way for the district to fund the replacement cycle of existing technologies. Likewise, when troubling economic times developed and when growth eventually slowed, several factors resulted: decreased funding equated to inability to sustain existing technologies as well as slowed the district's ability to fund new technology innovations. Thus, financial feasibility combined with continuous growth in student population and subsequent need for construction of new buildings aided the district in acquiring new technologies at the same time.

The fourth finding of this study is external pressures and influences were at play in all of the user-defined eras with respect to the selection and adoption of digital instructional technologies in this district. The first thing this district did in the first researcher-defined era was to contact other districts across the country and in close proximity to the chosen district to investigate what other districts were doing and what devices they had adopted, thus allowing both institutional theory and the concept of isomorphism to play a part in the initial planning phases of what digital instructional technology should look like in this district. In this case mimetic isomorphism played at least a small part as the response to uncertainty played a role in the district's pursuit of identifying what other like organizations were doing in this regard. As TECH3 stated later in the second user-defined era, "…I don't think there really was a definite goal in mind. Not a problem we were trying to solve. It was just a desire to be a leader in the state in acquiring technology. They had an advisor who had experience with what other school districts from the east and west coast were doing." Thus, this district felt external pressure to be a leader in the game – a pressure to stay ahead of others in the state in the adoption of innovation.

A fifth finding of this study underscores teacher beliefs surrounding the benefits of digital instructional technologies may be impacted by the teachers' non-involvement with the decision-making process for such technologies and impact teachers' frequency of use/nonuse. For example, when teachers were given CPS units, digital annotation devices and Palm Pilots without having asked for them, they were not used. When there was no instructional goal or identified problem to solve, they were provided anyway. This resulted in non-use and non-impact on teacher non-use and provided no chance for an impact on students. As the findings of the study show, the digital instructional technologies most frequently used by teachers in this district are the same technologies teachers identify as being the most impactful technology tools on student achievement and student engagement. However, if they weren't asked for, they often weren't used.

The final finding for this study is digital instructional technology adopted by this district has been in large part targeted at improving instruction as guided by various stakeholder priorities. The technology division's priority of the standardization of devices at all levels left little room for differentiation by level, by need or by technical core request. The digital instructional technology provided at all levels was prioritized by the technology division in large part, rather than the instructional (Teaching & Learning) division, with the thinking that the knowledge related to best practices and selection of technology resided with experts in the technology field. It was a stakeholder priority (district leadership) for technology to be in the hands of teachers to enhance and improve instruction as evidenced by the priority to equip all classrooms with digital instructional delivery types of technologies (IIPC carts, digital annotation devices, digital projectors). They wanted to see teachers moving about the room. As TECH5 remembers the impetus for the digital classroom model was wanting, "to not be tied to the front of the classroom. Those digital annotation devices provided that for them." Further, the introduction of laptops in the classrooms across the district was prioritized by district leadership as a need due to the desire to be a leader in delivery of Kansas state assessments on wireless laptops. Interestingly, educational factors such as the identification of specific digital instructional technologies device proven to be effective for improving student mathematics or reading achievement were not specifically stated as being used as a basis for adoption.

Collectively, the findings of this study contribute to the specific understanding of how adoptions of digital instructional technologies in a suburban Kansas school district have evolved over a period of thirty years and the factors influencing their adoptions. The goal of this qualitative case study was to explore and understand the factors influencing the adoption of digital instructional technology, and in doing so, contribute to the larger dialogue surrounding the educational benefits of the integration of digital instructional technology in the K-12 classroom.

Limitations

This study has several recognized limitations. As this study relied in part on self-reported data in the form of survey responses and interviews, there is potential for error or bias from participants as they attempted to recall information from as far as thirty years prior. This potential for error could be incorrect recollections or embellishment of recollection. Additionally, the participants in the survey has their own set of beliefs about technology and may have allowed that belief to color their responses. Moreover, participants may have a lack of firsthand knowledge regarding various components of the study and may have not revealed this to the researcher. Survey data was limited to veteran teachers having taught in the chosen district for at least twenty-five years; thus, many teachers were left out of the survey who may have had differing opinions and perceptions from the veteran teachers included in this study.

Policy Considerations

The adoption of digital instructional technology in Kansas and across the United States is funded in varying ways. In some districts technology adoptions are funded via capital outlay funds, others with general operating funds and some via successful bond elections. The varying methods for funding school district adoptions of digital instructional technologies lends itself to a fundamental policy consideration – that of a district's fiscally responsible investment of district patrons' tax dollars. Funding technologies that are not sustainable risks placing the financial stability of a district at jeopardy. Furthermore, funding technologies which have a short lifespan with bond money over a period of time after the technology has passed its usefulness could be argued as unwise policy and practice for a district. This is an area of policy consideration as it implicitly makes use of public funds for technology expenditures to be used immediately but paid for many years into the future – thus delaying the payment for such technologies in some instances for future generations. This is a practice critiqued by many districts and school boards of education.

Future Research

One of the goals of this study was to examine the factors impacting a district's decision to adopt digital instructional technology over a period of thirty years. The findings of this study were derived from veteran teachers and district business and technology staff, along with archived data over the same thirty year timeframe. Thus, the results of the study are an analysis of this data. Future research examining the perceptions, beliefs and academic impact of digital instructional technology over a period of time on one district's students would provide another perspective as to the longitudinal impact of one district's adoption of digital instructional technology. The rapid expansion of one-to-one digital instructional technology adoptions in the state of Kansas and across the United States underscores significant implications for further research on the impact of digital instructional technology on personalized and differentiated learning and the pedagogical change and strategies in the K-12 classroom. Instructional methods such as flipped learning, provided by one-to-one technology initiatives, to provide increased meaningful learning environments for students at the K-12 level, is another area where further research is needed. Finally, as digital instructional technology adoptions increase to include personalized learning opportunities through one-to-one initiatives, follow-up research studies should include a longitudinal study on student outcomes, both academically and socially, to explore if and to what degree there is an impact on students over a longer period of time.

Appendices

Appendix A
District Technology Leaders Interview Guide

Interview participants: Current and Past District Technology Leaders (n=6)

<u>Introduction to Research</u>

A. Brief Description and goals of the research study
B. Purpose of interview data collection and how it will be used (e.g. dissertation/journal article)

<u>Background Information</u>

A. Verify responsibilities at time of technology leadership role in district during each identified era
B. Verify other district technology staff roles at time of leadership role in district
C. Verify other district staff roles with respect to impact on technology decisions at time of leadership role in district

<u>History of Evolution of Digital Instructional Technology in the District</u>

A. Personal level of involvement in selection, purchase and adoption of educational technologies in the district within each era
B. What was the process to officially adopt various technology innovations?
C. Has the process changed over time?
D. What types of due diligence were performed to promote success?
E. What prompted the district to seek to adopt new technologies?
F. Was there a problem needing to be solved?
G. Have there been differing problems in the identified eras?
H. Who are the key players / stakeholders in the process?
I. Did you feel a sense of pressure to adopt your own program based on other districts' experiences with educational technologies?
J. How were decisions made regarding how to fund digital instructional technology innovations?
K. How have funding challenges differed in the three identified eras?
L. How was the director of curriculum involved in the process?
M. What do you feel should be high priorities for digital instructional technology in the near future?
   (e.g. structural changes, expansion of innovations, funding changes)
N. Would you have done anything differently with respect to digital instructional technology initiatives, if you could go back and revise any aspect of any initiative?

<u>Student Impact</u>

A. What do you feel has been the most significant impact of digital instructional technology on students?

B. What do you feel has been the most significant impact of digital instructional technology on teachers?

Challenges/Benefits

A. What do you feel are the top three challenges facing district technology leaders in the area of digital instructional technology decision making?
B. What are the top three benefits educational technologies provide to students? To staff?
C. What are the top three challenges to the use of educational technologies for students? For staff?
D. Do you feel any of these challenges and benefits are unique to this district?
E. With the future in mind, what would you change about digital instructional technology in this district to prepare students for their lives once they graduate, even if these changes may be idealistic due to real world constraints?

Appendix B
Business Office Director/CFO Interview Guide

Interview participants: Current and Past Chief Business Officers (n=3)

<u>Introduction to Research</u>

A. Brief Description and goals of the research study
B. Purpose of interview data collection and how it will be used (e.g. dissertation/journal article)

<u>Background Information</u>

A. Verify demographics of district and school at time of leadership role in district
B. Verify other district technology staff roles at time of leadership

<u>History of Evolution of Digital Instructional Technology in the District</u>

A. Personal level of involvement in selection, purchase and adoption of educational technologies in the district
B. What was the process to officially adopt various technology innovations?
C. What types of due diligence were performed to promote success?
D. What prompted the district to seek to adopt new technologies?
E. Was there a problem needing to be solved?
F. Who the key players / stakeholders in the process?
G. Did you feel a sense of pressure to adopt your own program based on other districts' experiences with educational technologies?
H. How were decisions made regarding how to fund digital instructional technology innovations?
I. How was the director of curriculum involved in the process?
J. What do you feel should be high priorities for digital instructional technology in the near future?
(e.g. structural changes, expansion of innovations, funding changes)
K. Would you have done anything differently with respect to digital instructional technology initiatives, if you could go back and revise any aspect of any initiative?

<u>Student Impact</u>

A. What do you feel has been the most significant impact of digital instructional technology on students?
B. What do you feel has been the most significant impact of digital instructional technology on teachers?

<u>Challenges/Benefits</u>

A. What do you feel are the top three challenges facing district business officials in the area of digital instructional technology decision making?

B. What are the top three benefits educational technologies provide to students? To staff?
C. What are the top three challenges to the use of educational technologies for students? For staff?
D. Do you feel any of these challenges and benefits are unique to this district?
E. With the future in mind, what would you change about digital instructional technology in this district to prepare students for their lives once they graduate, even if these changes may be idealistic due to real world constraints?

Appendix C
HSCL – Interview Participants
Interview Information Statement – University of Kansas – Doctoral Research

The Department of Educational Leadership and Policy Studies at the University of Kansas supports the practice of protection for human subjects participating in research. The following information is provided for you to decide whether you wish to participate in the present study. You should be aware that even if you agree to participate, you are free to withdraw at any time without penalty.

We are conducting this study to gain important insights into the process of technological adaptation in a *large suburban school district*. The district's identification will remain anonymous in the study. Your participation will entail your completion of an interview by the researcher. Your participation is expected to take approximately one hour to complete. The content of the interview should cause no more discomfort than you would experience in your everyday life.

Although participation may not benefit you directly, we believe that the information obtained from this study will help us gain a better understanding of how digital instructional technology tools are obtained and used in education currently and historically. Your participation is solicited, although strictly voluntary. ***Your name will not be associated in any way with the research findings***. Any identifiable information will not be shared unless (a) it is required by law or university policy, or (b) you give written permission. ***Confidentiality of all records will be maintained through the use of passwords and at no time will the identity of the subject be known – unless you provide your name voluntarily at the end of the survey.*** *You will not be paid for your participation in this study.*

If you would like additional information concerning this study before or after it is completed, please feel free to contact us by phone or mail.

Completion of the interview indicates your willingness to take part in this study and that you are at least 18 years old. If you have any additional questions about your rights as a research participant, you may call (785) 864-7429 or write the Human Subjects Committee Lawrence Campus (HSCL), University of Kansas, 2385 Irving Hill Road, Lawrence, Kansas 66045-7563, email irb@ku.edu.

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Appendix D

Teacher Survey: Longevity of at Least 25 Years in District

Interview participants: Teachers in District with Longevity >=25 years (n=165)

Demographics and Background Information

Thank you for participating in this research study. The results of this survey will be kept confidential. Participation is anonymous and is targeted at veteran teachers who have been employed with the chosen district for at least 25 years. The results will be used to assist the researcher with understanding the factors influencing a teacher's decision to use varying types of currently-available instructional technology as well as technology available in past years.

Please identify your gender.

- Male
- Female

Please identify your highest level of education.

- Bachelor's Degree
- Master's Degree
- Doctoral Degree

Including the current year, how many years of total teaching experience do you have - including years outside of this district?

- 20 - 25 years
- 26 - 30 years
- More than 30 years

At what grade level are you currently teaching?

- Elementary
- Middle School
- High School
- Other (Alternative, Early Childhood, etc.)

What middle or high school curricular subject or elementary grade level do you teach?

- MS or HS Humatities: (Language Arts/Reading, Psychology, Social Science)
- MS or HS STEM (Science, Technology, Engineering, Mathematics)
- MS or HS Special Education Teacher
- MS or HS Other Non-Core Subject Area: (Fine Arts, Physical Education, FACS, etc.)
- Elementary Classroom Teacher (Grade Level Teacher)
- Elementary Subject-Specific Teacher (Physical Education, Fine Arts, etc.)
- Elementary Special Education Teacher
- Other

Historical Teacher Technology Use

At what point in your career with this district did you first begin to regularly integrate available instructional technology in your classroom?

- 1984 - 1993
- 1994 - 2003
- 2004 - Present
- I do not regularly integrate instructional technology.

During the timeframe 1984-1993, which of the following types of instructional technology did you use regularly use in your classroom for instructional purposes?

- Apple Desktop Computer
- Audio Tape Recorder
- Filmstrip Projector
- Overhead Projector
- Laser Disk Player
- Radio or Educational Television
- Other
- Other

During the timeframe 1994-2003, which of the following types of instructional technology did you use regularly use in your classroom for instructional purposes?

- PC Computer
- Apple Computer
- Laptop Computer
- Palm Pilot
- Interactive Whiteboard (Mimio, SMART Board, etc.)
- Digital Video Projector
- VHS Player
- DVD Player
- Other
- Other

In the years since digital classrooms became a standard for all classrooms in this district (2004-Present) which of the following types of technology have you regularly used and integrated in your classroom for instructional purposes?

- Windows Laptop Computer
- Apple Laptop Computer
- PC Desktop Computer
- Digital Video Projector
- VHS Player
- DVD Player
- Wireless Keyboard/Mouse
- Interactive Digital Annotation Device (Airliner, iWrite, SMART Board, etc.)
- Classroom Response Systems (clickers)
- Palm Pilot
- iPad or Tablet Computer
- Other
- Other

Which (if any) of the following types of instructional technology tools have you never chosen to use regularly at any point over the duration of your career with this district?

- Classroom Response Systems (clickers)
- Palm Pilot Handheld Computers
- Digital Annotation Devices (Airliners, iWrite Tablets)
- Wireless Keyboard and Mouse
- Document Camera
- Digital Video Projector

In general, how would you describe your adoption and integration of instructional technology over the duration of your career with this district?

- Quick to adopt any new technology in the classroom.
- Usually wait to adopt new technology with the "majority" of other teachers.
- Tend to be with the group of teachers that is last to adopt new technology in the classroom.
- In general, I do not integrate technology in the classroom.

Current Teacher Technology Use

Each type of instructional technology listed below is currently available for use by many teachers in this district. For each instructional technology listed below, indicate your current frequency of classroom use for instructional purposes.

	Frequency of Current Use			
	Frequent (Two or more times per week)	Somewhat Regularly (several times per month)	Infrequent (Not on a regular basis)	Do Not Use
Digital Projector	○	○	○	○
Interactive Whiteboard (SMART Board, iWrite or Airliner)	○	○	○	○
Document Camera	○	○	○	○
Video or Still Camera	○	○	○	○
Desktop or Laptop Computer	○	○	○	○
iPad or Tablet Computer	○	○	○	○
Clickers (Student Response System)	○	○	○	○

To what extent do or did the following factors influence your decision to use instructional technology in your classroom? Slide the vertical slider to the right to the desired indicator value.

	No Influence 1	Moderate Influence 2	Strong Influence 3
Ease of Use			
Availability of Device			
Level of Training Provided			
District-Driven Initiative			
Personal Technology Interest/Proficiency			
Collegial Pressure			
Impact on Student Engagement and/or Student Learning			
Dependability of Device/Technology Support			
Makes Job/Tasks Easier			

For each instructional technology listed below which you do NOT use regularly, indicate the primary reason(s) for not utilizing the technology. Check all that apply and are primary reasons why you do NOT use the specific technology device.

	Primary Reasons for Current NON-Use of Technology Devices							
	Not Easy to Use	Not Available	Lack of Training	No Impact/Benefit on Job Efficiency	No Personal Interest in the Technology	No Impact on Student Engagement and/or Student Learning	Device is Not Dependable	Lack of Technology Support
Digital Projector	☐	☐	☐	☐	☐	☐	☐	☐
Interactive Whiteboard (SMART Board, iWrite or Airliner)	☐	☐	☐	☐	☐	☐	☐	☐
Document Camera	☐	☐	☐	☐	☐	☐	☐	☐
Video or Still Camera	☐	☐	☐	☐	☐	☐	☐	☐
Desktop or Laptop Computer	☐	☐	☐	☐	☐	☐	☐	☐
iPad or Tablet Computer	☐	☐	☐	☐	☐	☐	☐	☐
Clickers (Student Response System)	☐	☐	☐	☐	☐	☐	☐	☐

Teacher Technology Perceptions and Beliefs

On a scale of 1 to 5 (1= perceived effectiveness is low; 5 = perceived effectiveness is high), indicate your belief in the strength of perceived effectiveness of each instructional technology as it impacts the three areas listed below.

	Improved Delivery of Instruction	Increased Student Engagement	Increased Student Achievement
Digital Projector			
Interactive Whiteboard (SMART Board, iWrite or Airliner)			
Document Camera			
Video or Still Camera			
Desktop or Laptop Computer			
iPad or Tablet Computer			
Clickers (Student Response System)			

How would you describe your beliefs regarding instructional technology?

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
I believe technology functions as an effective tool for helping students master the state academic content standards.					
I believe the use of technology makes the process of learning more interesting for students.					
I believe the use of technology saves me time on routine tasks.					
I believe technology improves the effectiveness of my teaching.					
I believe technology makes my job more interesting.					
I don't believe technology significantly impacts my teaching.					
I don't believe technology significantly impacts student learning.					
I believe funds spent on technology are appropriately allocated.					
I believe funds spent on technology are necessary expenditures.					

Would you be willing to be selected for a follow-up interview to provide more in-depth responses?

- Yes
- No

If answering yes to the above question, please provide your name below. Not all volunteers will be chosen. The researcher will select volunteers randomly to be chosen for a short interview at a convenient time.

Thank you for your participation in this survey!

Appendix E

Introductory email to teacher survey participants

To: Certified Teachers (with at least 25 years of In-District Experience)

I am a doctoral candidate at the University of Kansas in the Educational Leadership and Policy Studies program. I am requesting your participation in a survey related to my doctoral studies.

You have been selected due to your experience in the district (at least 25 years). Details of the survey are included below. Your participation is anonymous and will provide rich information for this study. The survey should take no longer than 5 to 10 minutes to complete. The survey link will be open beginning today through 5 p.m. Friday, June 20th.

I would greatly appreciate your consideration and participation.

If you would, please access and complete the short survey using the link here: https://kansasedu.qualtrics.com/SE/?SID=SV_eLMbVoVTw2uiWYR

Thank you!
Connie Smith
Doctoral Candidate
University of Kansas

Appendix F
HSCL – Survey Participants
Internet Survey Information Statement – University of Kansas – Doctoral Research

The Department of Educational Leadership and Policy Studies at the University of Kansas supports the practice of protection for human subjects participating in research. The following information is provided for you to decide whether you wish to participate in the present study. You should be aware that even if you agree to participate, you are free to withdraw at any time without penalty.

We are conducting this study to gain important insights into the process of technological adaptation in a *large suburban school district*. The district's identification will remain anonymous in the study. Your participation will entail your completion of an online survey. Your participation is expected to take approximately 15 minutes to complete. The content of the survey should cause no more discomfort than you would experience in your everyday life.

Although participation may not benefit you directly, we believe that the information obtained from this study will help us gain a better understanding of how digital instructional technology tools are obtained and used in education currently and historically. Your participation is solicited, although strictly voluntary. ***Your name will not be associated in any way with the research findings***. Any identifiable information will not be shared unless (a) it is required by law or university policy, or (b) you give written permission. ***Confidentiality of all records will be maintained through the use of passwords and at no time will the identity of the subject be known – unless you provide your name voluntarily at the end of the survey.*** *You will not be paid for your participation in this study.*

If you would like additional information concerning this study before or after it is completed, please feel free to contact us by phone or mail.

Completion of the survey indicates your willingness to take part in this study and that you are at least 18 years old. If you have any additional questions about your rights as a research participant, you may call (785) 864-7429 or write the Human Subjects Committee Lawrence Campus (HSCL), University of Kansas, 2385 Irving Hill Road, Lawrence, Kansas 66045-7563, email irb@ku.edu.

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Appendix G
Teacher Interview Guide

Interview participants: Teachers in District with Longevity >=25 years (n=7)

Introduction to Research

A. Brief Description and goals of the research study
B. Purpose of interview data collection and how it will be used (e.g. dissertation/journal article)

Background Information

A. Verify demographics of the teacher's school during each identified era
B. Verify other building-level technology roles at time of leadership (tech team, etc.)

History of Evolution of Digital Instructional Technology in the District

A. Teacher's level of involvement in selection, purchase and adoption of educational technologies in the district
B. Understanding of the process to officially adopt various technology innovations?
C. What types of due diligence were performed to promote success?
D. What prompted the district to seek to adopt new technologies?
E. Was there a problem needing to be solved?
F. Who the key players / stakeholders in the process?
G. What do you feel should be high priorities for digital instructional technology in the near future?
(e.g. structural changes, expansion of innovations, funding changes)
H. If you could have been given the opportunity to influence past district technology initiatives, what aspects of the initiatives would you revise, if any?

Student Impact

A. What do you feel has been the most significant impact of digital instructional technology on students?
B. What do you feel has been the most significant impact of digital instructional technology on teachers?
C. Do you feel digital instructional technology has had a significant impact on student learning?

Challenges/Benefits

A. What do you feel are the top three challenges facing teachers in the area of digital instructional technology decision making?
B. What are the top three benefits educational technologies provide to students? To staff?
C. What are the top three challenges to the use of educational technologies for students? For staff?

D. Do you feel any of these challenges and benefits are unique to this district?
E. With the future in mind, what would you change about digital instructional technology in this district to prepare students for their lives once they graduate, even if these changes may be idealistic due to real world constraints?

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